THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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STUDYING THE CONSUMER.

"THE electrical companies are now realising as never before that a satisfied consumer is one of their best assets."

This sentence is taken from a report presented to the National Electric Light Association at a recent meeting in Boston, U.S.A., by Mr. F. W. Frueauff, which, while professing to deal only with "Office Methods and Accounting," in reality goes further, and insists that "thoroughness" must be the settled policy of all connected with an undertaking if that undertaking is to be a real success. For this reason it is worthy of more than passing notice, for in how many electrical as well as in other classes of undertakings in this country is there need for the cultivation of this virtue! Its absence in many cases is sufficient to account for the failure, and in far more for the indifferent success, of what might be a highly prosperous concern.

In electricity supply work the fact that "a satisfied consumer is one of the undertaking's best assets," is rarely realised to its full extent. The management feel that in the electric light they have a formidable rival to other illuminants, and that in their Acts of Parliament and provisional orders they have weapons with which it is easy to browbeat complaining consumers. Instead of cultivating good relations with their clients, they are too prone to mystify them with their elaborate systems of charging, and their stringent conditions of supply, until they submit to what they do not understand with an unwilling grace which acts prejudicially on the popularity of the concern.

There are, fortunately, many exceptions to the above, and most of our readers will acknowledge that these exceptions are usually prosperous concerns where good management within finds its counterpart in friendly relations with clients without.

The report referred to, written by a leading official of the Denver Gas and Electric Co, details some of the steps taken inside and outside the office of his company to attain this desirable end. For example, whenever a complaint is received full details as to time and nature are recorded, and an order is at once written out in duplicate for an inspector to investigate, and, if possible, remedy it. One copy of this order is retained in the office to ensure that the matter is not overlooked. The inspector examines and, in most cases, cures the fault and reports the result. A reply postcard is then sent to the client, asking if the matter is now quite right. Often no reply is returned, but the attention given to the matter pleases and gives satisfaction to the consumer. In how many stations in this country would similar courtesy be shown?

A further instance of the "thoroughness" of the company's methods is the establishment of a Bureau of Information in a convenient and prominent part of the office. They place in charge not the newest office boy, but a responsible official, "thoroughly posted on all general matters of the

company." It is his duty to interview visitors and direct them to the official having their particular business in hand. He also keeps a list of all desirable property to be let *in streets along which the company have distributing mains*, and directs applicants to the estate agents interested in the various premises. Great care is taken to keep this list up to date, and it is found to be a valuable aid in securing additional customers at a minimum capital outlay.

Particular attention is paid to the keeping and dissecting of the costs of production, distribution, and management, not merely to get the "average," but the particular cost when working under varying conditions. This knowledge is of great value in determining the lowest profitable prices which can be charged to particular consumers. It will be remembered that Mr. Arthur Wright has done great service to the industry in impressing upon it the differences which may exist at different periods in the cost of production, and probably in this particular direction we have little to learn from our trans-Atlantic friends.

Turning our attention to questions of indoor management, we find that the report lays great stress on exactness. Good time-keeping on the part of the office staff is insisted upon, careful records being kept and lists posted up every month of the names of those members of the staff who have been prompt and punctual. The same publicity is given to the results of inspections by the various members of the staff, and, as far as possible, the same principle is extended to those engaged on other duties. In this way, it is claimed that the principle of "thoroughness" is applied, with the result that the spirit of emulation in good work is fostered.

One novel duty of the Bureau of Information referred to above is to see that all members of the staff are posted up with information as to every new advertisement inserted in the papers, so that they may intelligently answer any question they may be asked about it.

It is almost needless to add that in such an up-to date establishment as this the card system of filing information has been adopted and brought to a high state of perfection. An enumeration of the heads under which particulars of installations are classified are of interest to the expert but only a source of bewilderment to the ordinary visitor. It is considered that the saving of worry and of the time of the principal officials, repays the expenditure in capital and labour which the keeping up of these records entails.

All clerks are expected to be able to use the slide rule, and as far as possible mechanical appliances replace human agencies in adding, calculating, and tabulating work. The report does not deal with the generating station, but enough has been said to show how important shrewd business men consider the satisfaction of consumers to be. This forms one of the best and most valuable assets of any undertaking, and it can only be attained by the production of the best article at a cost low enough to enable it to be sold at a reasonable rate. Success can be attained not by slavishly following the methods mentioned in the report, but by the cultivation of the spirit of thorough whole-hearted service running right through every department. There are such possibilities of success in the electricity supply industry that given this spirit, there are few undertakings which will not soon show satisfactory results.

Secondary Radiation Excited γ Rays.

PASCHEN found that a thick block of lead containing radium emits negatively electrified particles which can be deflected by a magnet. He concluded from his experiments that, contrary to previous experience, the γ-rays from radium were deflected by a magnetic field. Mr. A. S. Eve, of McGill University, Montreal, shows, however, in a letter to *Nature*, that Paschen was mistaken in this conclusion. It appears that the γ rays are capable of exciting a secondary radiation in lead, consisting of negative corpuscles. The γ rays, which are now generally considered to be an extremely energetic form of the Röntgen rays, evidently have the power of detaching the negative corpuscles or electrons from the atoms of lead and projecting them into space. As Mr. Eve remarks, any experiment designed to prove that the primary γ-rays can be affected by the magnetic field must involve evidence that the effect produced is not due to the easily deviated secondary radiation.

Ionisation of the Atmosphere.

THERE is already much evidence to show that the percentage of free electrons in the atmosphere is an important element in the weather, and greatly influences its effect on the human physiology. An excess of positive electrons, for example, is known to be the cause of mountain sickness, and sickness produced by certain winds which blow down into the valleys from high mountain ranges. The experiments of Elster and Geitel in Germany, and of Don in this country, have shown that part at least of the ionisation of the atmosphere is due to a radio-active emanation from the soil which, as might be expected, increases in amount when the barometer falls. Mr. Ashworth, in a letter to *Nature*, demonstrates the existence of another source of atmospheric ionisation, namely, the breathing of animals. He found that the air exhaled from the lungs increased the rate of discharge of an electroscope from 60 to 70 per cent. The electroscope was connected to an insulated rod placed inside a metal tube connected to earth, care being taken to screen the insulation of the rod from the breath. As Mr. Ashworth points out, this ionising effect of human breath is probably the explanation of the difficulty found in carrying out electrostatic experiments before a large audience.

Broken Axles.

WE hear from several parts of the country of car axles breaking with annoying frequency. The probable causes we have indicated previously. They are to be found mostly among the following:—Axles too small; rigid wheel base; inaccurate gauging of wheels or of rails; bad track; key-ways sunk into already scant section, and cut with sharp corners. There may be others, but these will do to go on with. The remedies, where any are possible, will be obvious. Unless the whole truck is reconstructed and the motor suspension brasses are made for larger diameters, it will be impossible in most cases to put in larger axles. All that can be done in that direction is to forge new axles with swelled key-seats, the remainder of the axle to remain as of old. Sometimes the old pattern gear-wheels can be bored out to suit, but it is probably better to buy new pattern gear wheels with enlarged hubs.

Assuming that axles will break, the great question is—Can the fracture be discovered before the final catastrophe? If so, much additional expense may be avoided, for a car with a broken axle has to be cleared off the road without delay, and we do not know any speedier way to accomplish this than the cruel one of locking the wheels by binding them to the truck with chains, and getting home with the help of a healthy car pushing or pulling, aided by one motor of the

crippled car. That is an effective, speedy, and safe method, so long as ordinary care is taken when passing over curves and through points, but it involves, necessarily, the ruin of two wheels, which together cost far more than the broken axle for which they suffer.

Unfortunately so much of the axle is concealed from sight permanently when in position, that any effective examination of its surface, and especially of those parts which are most liable to fracture, is quite impossible, so that we have to put aside any idea of discovering latent trouble while a car is still in service.

Thorough overhauling takes place, say, every 7,000 miles, while axles are sold freely with a five years' guarantee. If then every axle is subjected to minute examination at every overhaul, there will be between two and three chances of detecting incipient flaws every twelve months, while the guaranteed life will be guarded by about fifteen inspections.

From the appearance of a large number of fractures, we have reason to believe that a considerable interval of time elapses between the appearance of a transverse surface crack and the final breakage, so that careful inspections as above should result in a decrease of casualties on the road quite sufficient to warrant the slightly increased expense involved.

The tapping test is of little use in this connection, and a sufficiently minute examination with a lens cannot be expected, unless a special inspector is retained for the job. The most certain, and the most easily applied, test, is made by putting the axle under pressure in the wheel-press, and after carefully cleaning it, watching for the appearance of a thin line of oil, which proclaims a crack without a doubt. The gear-wheel should be removed for this test, but the running-wheels need not be disturbed.

When buying new axles it is of the first importance that they be obtained from a firm which has a reputation for axles. The ordinary steelmaker can supply stuff which fulfils every requirement in the way of tensile tests and elongation, but will succumb early to the concussions inseparable from street traction.

Mathematics in Engineering.

In discussing the question of mathematics in engineering in *Cassier's Magazine*, Mr. Thorburn Reid appears to fall into the error of supposing that the mathematician must necessarily be the accurate man and the non-mathematician must be a mere rule-of-thumb man. This association of men and their capacities is quite wrong. Because a man is not a mathematician it does not follow that he is a rule-of-thumb man. More likely he keenly regrets his lack of facility with even the simpler mathematics, but this lack does not prevent him thinking clearly. It does prevent him from solving certain problems and taking short cuts to a solution, but it does not prevent him, as Mr. Reid seems to say, from knowing how to line out the correct basis of solution. He complains of the way in which mathematics is taught. Prof. Perry considers mathematics to be a useful tool, to be acquired and used by the engineer even if the user is not really a mathematician. To the professed mathematician this is heretical. He would bar mathematics to anyone not understanding them as a mathematician. His attitude, in fact, is that of the farmer who would bar butter to all who could not make it. The practician, to use the author's own words, if capable of clear thought, will use all the mathematics of which he is capable. Many engineers of absolute soundness are very slow and clumsy over mathematics. Slowness in mathematics is quite compatible with a remarkable facility in the use of figures. Mere arithmetic is not mathematics, nor is mathematical ability to solve difficult problems in engineering any sign of an engineer. Happy is the real engineer who possesses good sound mathematical knowledge. The worst of the mere mathematician is his finnicking ways; he does not know what his answer is going to be. The less skilful man, who is an engineer and knows the answer, will often secure better results from his cumbrous troubles than the mathematician who drops a figure inadvertently and gets an answer that he cannot see is wrong.

In engineering it may not inaptly be said of mathematics what has so often been said of the slide rule, that it is a very useful instrument if you know your answer. *A propos* of this an engineer was taken to task by a professor over the position of a decimal point in a row of figures representing a cubic measure in the metrical system. The engineer said it certainly could not be so small as cubic centimetres, and cubic metres were impossible. Therefore it must be decimetres; never mind the dots.

The author very truly points out that the processes of mathematics must not be allowed to supplant reasoning, sense and judgement.

Steam Pipe Coverings.

There appears to be no finality in the matter of steam pipe coverings. A recent paper by Mr. S. H. Davies, is now commented upon by Prof. S. P. Thompson, who finds that the conclusions drawn by Mr. Davies are wholly at variance with the results of the trials, and also with conclusions he has himself drawn. The latter showed mica to be superior to asbestos or magnesia. Remanite, or silk waste, is excluded by Prof. Thompson as inflammable. Mr. Davies also neglected to account for thickness, and so Prof. Thompson has calculated the results afresh on the basis of 1-inch thickness. Prof. Thompson thus finds that a mica covering heads the list, but he also finds three other mica coverings at the bottom of the list. Is it possible that the best of the mica coverings was in the form of sheets, and that the others use powders? A series of sheets of mica would hold much air in thin layers, and would be an ideal covering. Prof. Thompson's criticism does not put us in a much better position. He gives the following table as his own calculation from Mr. Davies's figures :—

Material.	Thickness used.	Calories lost per hour (Davies).	Ditto, if reduced to 1 in. thickness.
Remanite (waste silk)	$\frac{7}{8}$	60	52·5
Mica, sectional, single	$\frac{7}{8}$	74	65
Magnesia, sectional, single ...	$\frac{3}{32}$	83	80·5
Magnesia, sectional, thick ...	$1\frac{1}{2}$	55	82
Slag wool, sectional	$1\frac{3}{16}$	60	86
Asbestos board and hair felt ...	1	91	91
Morley's composite	$1\frac{3}{4}$	63	110
Asbest s rope with magnesia ...	$\frac{15}{16}$	118	111
Mica, sectional, double	2	61	122
Mica, sectional, thin	$1\frac{1}{2}$	74	130
Mic , sectional, thick	2	68	136

To do Mr. Davies justice, however, he stated in his paper that the results given by his tests were not altogether comparable, because of the different thickness of the materials employed. What he wished to discover was not the best material per section, but the best covering as supplied by makers, and he gave a table showing the weight of the various materials experimented with as a guide in case of weight being of importance. It is not certain that all materials useful for pipe covering can be worked up into thin coverings that will also be durable. It is by no means convincing, however, that the use of an electric heater will obtain the same results as would be given with steam heating. The assumption that it will, neglects the skin effect altogether. To neglect the conductivity of the iron pipe may be all right. It is not the property of conductivity that appears to be the most important in regard to heat loss. The picking up of heat on the steam side may be, we do not say is, of much greater importance, and it is just at this boundary that possible errors creep into the method of electric heating of these covered pipes. Otherwise the electric heater is most convenient.

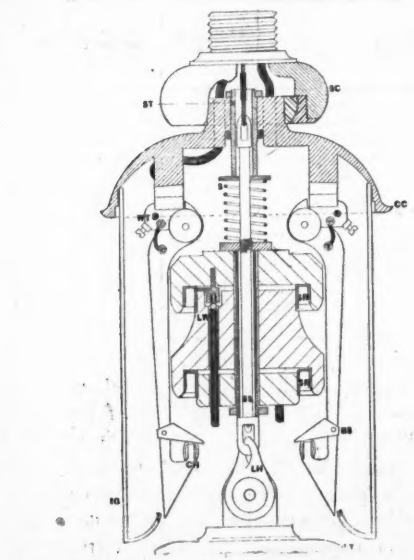
D—

RAISING AND LOWERING GEAR FOR ARC LAMPS.

By DONALD SMEATON MUNRO.

It is general practice in this country to have fixed arc lamps for street lighting. It is also common experience that the constant cleaning, overhauling, and carboning of these lamps is a very laborious and expensive matter. The usual method is to send groups of three men and a tower ladder round the lamps. There is much time wasted in getting through traffic and repeatedly raising the ladder. The man at the top cannot clean the lamp so thoroughly as is possible on the ground, and accidents are constantly occurring when men are working over the heads of passing people.

The advantages of lowering the lamps instead of climbing to them are obvious, and lowering apparatus which is at the same time safe, simple, and sightly, should become popular, while it is undoubtedly very economical.



Index:—S C, Swivel cap; S T, Stopper tube; S, Spring; W T, Wire terminal; C C, Cast-iron cap; L W, Lamp wire; S S, Socket copper rings; S S, Steel spindle; B S, Brass shutters; C H, Contact hook; I G, Iron guide; L H, Lamp hanger; L T, Lamp top.

Fig. 4.

Nearly every manufacturer and contractor having to do with arc lamps has been called on at some time to design a raising and lowering gear. Some of these have been ingenious enough, yet I know of none, hitherto on the market, of which all the necessary points have been fully considered. The result is that practical men have little faith in such gear, and therefore either fix their lamps permanently in position or use swing exposed conductors which rise and fall with the lamps.

Evidently there must be something seriously wrong with available appliances when methods so unsightly and inconvenient are in all but universal use. The points of a good gear are:—

1. "Guid gear gangs in sma buik"; neatness is essential.
2. Contact when made should be secure and reliable under all conditions of weather and wear.
3. The man raising the lamp should have ready means of knowing when the lamp is "home."
4. It ought not to be possible to overwind the gear or put an undue strain on the suspension wire or other part.

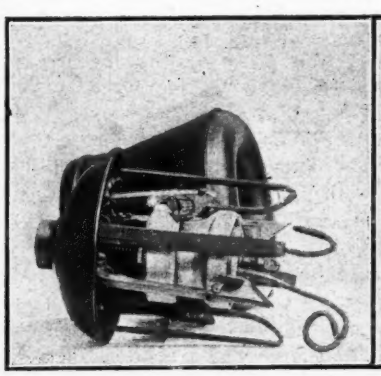


Fig. 1.

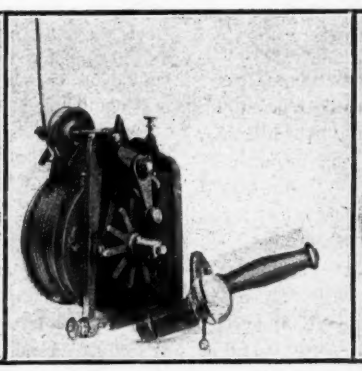


Fig. 2.

Fig. 3.

5. The weight of the lamp should be taken off the suspension wire when "up."
6. The arrangements for release when lowering should be strong and simple.
7. While the lamp is down out of socket, neither the contact surfaces nor insulating parts should be exposed to rain or snow.
8. The chief insulating material should be strong, enduring, and unaffected by damp.
9. Conductors within poles should be protected from risk of chafing by the running cord.
10. None of the cables carrying current should be at any time exposed to the weather.
11. All parts, and particularly moving parts, should be of a size and substance not readily corroded by damp.
12. The winch should be provided with a device to prevent the lamp from descending too rapidly.
13. Means should be provided whereby workmen before leaving the lamp-post could rapidly ascertain whether the lamp was in full contact and the lamp circuit good.
14. A swivel or cushion suspension is useful, so that the lamp may at all times hang plumb and be unaffected by wind or other source of disturbance.

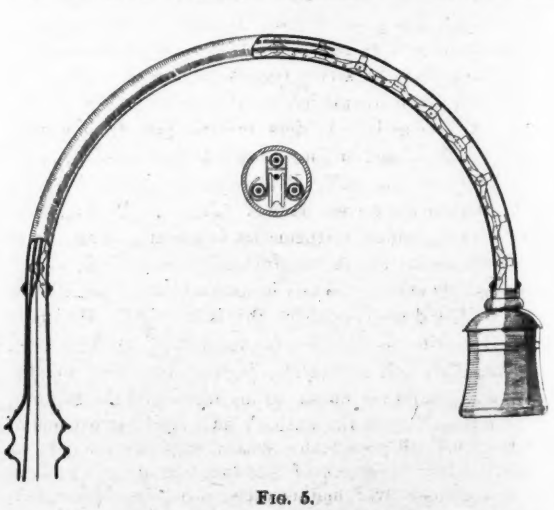


Fig. 5.

It would be too long a task to describe all the methods in the market, so one is selected which appears to the writer to very fully meet the foregoing requirements. It is the pro-

perty of the North-Western Electrical Appliance Co., Railway Works, Cathcart, Glasgow.

The apparatus consists of suspender contacts, a chain with pulley links for passing round the swan neck of the pole, and an improved form of winch for the inside of the pillar base. Figs. 1 and 3 are different views of the suspender contacts with the outer zinc cover removed, and fig. 4 is a vertical section through this part.

It will be seen from these illustrations that the cables passing down the neck of the pole are attached to terminals close under the top cast-iron cap, and in a position where they are well out of reach of any moving part. There are altogether four terminals under this cap, the two positive being directly opposite each other, and on the diameter which is at right angles with these are placed the two negative terminals, also opposite each other. In the section, terminals of only one polarity are shown for clearness. Directly connected with and hanging from these terminals are cast-brass contact suspenders. The suspenders normally hang vertical in the position shown, but are free to swing outwards. They have specially designed hooked ends for the double purpose of conveying current to and supporting the weight of the lamp. Above the hooks are fitted little pivoted brass shutters, which either lie on the hook ends, as shown in the section, or are opened by upward pressure on their points, and so leave easy entrance to the hollow of the hooks.

The four suspenders are so simple and substantial that it is difficult to see how they could give trouble; and they, with their weather-protecting cover, compose the part of the contact appliance which is permanently fixed to the neck of the post. The framing and cover are designed to guide the lamp smoothly into position, although the cord itself also does so.

Attached to the lamp-top and the suspending cord is a double-petticoat insulator fitted with annular copper rings, which are in electrical connection with the two conducting wires for the lamp. The method of attachment of one of these wires is shown in the section, and it will be seen how well protected at all times are the copper contact-rings from damp or mechanical injury. A central steel spindle passes through this insulator, and on the upper end is fitted a stout spring to check too forceful hauling on the suspension cord.

The heavy china insulator, of course, moves up and down with the lamp, and in the section is shown in the "ready for lowering position." As it moves downward the bottom rounded edge of the insulator presses on the bevel top of the brass shutters on the suspenders, the suspenders are thus thrust outwards and the lamp and insulator are free for lowering to the ground. Fig. 1 shows the suspenders in this out position, and with the insulator in the act of passing downward When the lamp is raised again, the bevel top of the insulator lifts the brass shutters and leaves the way clear for the suspender hooks to enter the copper rings, and the insulator with lamp attached is then dropped into the position shown in fig. 3. The weight is thus taken off the cord, so adding to its life; and even should the cord break, the lamp would not fall. This method is, I think, unique in the fact that the weight of the lamp is applied to make very close electrical connection. In most appliances of the kind the contacts merely depend on their own springiness, or the weight of the lamp tends to pull the contacts away from each other. Bad connection causes the contacts to heat, and very soon they have lost whatever spring they had. It is a serious defect if, when contacts are lowered with the lamp, they expose cable, small springs, or contact surfaces to rain, snow, or dust. This is a sure way to get trouble after the lamp is in position, and some makers actually provide cup-shaped recesses in such gear as if to retain as much water as possible.

Pillar arms do not always have their ends so vertical as they ought to be. Fig. 4 shows a swivel cap which may be provided when wanted. It is also useful when windy weather tends to make the feed of the lamps irregular. The appliance is readily adapted for three contacts for substitutional resistances when required.

When a running cord and insulating conductors are combined in one tube there is an obvious risk of injury to insulation. An inner iron or copper tube to provide a smooth surface for the running cord cancels this risk, but the system we are examining aims at perfection in all points.

A chain (fig. 5), which can be readily drawn in or out of the curved arms of existing poles, provides protected channels for three conductors and a fourth guiding channel fitted with small pulleys for the suspension wire. The same figure shows a section through the chain on a larger scale. The ends of the chain are constructed so that all wires are kept well apart.

Any ordinary winch may be used with the foregoing gear, but a special one has been designed for it which has some novel features. Its general appearance is shown in fig. 2. Besides the usual drum it has a guide pulley, so that the cord may wind without jerks. The axle of the guide pulley is carried by two pivoted arms. A band brake is attached to this axle, so that the brake power is applied automatically when any attempt to overwind puts a strain on the cord. This brake is also self-applied when the lamp is descending; and, with normal pull, is slackened when ascending, by means of a ratchet and tumbling cam. The barrel is large to allow of quick winding and long life of cord. The whole winch is of rather better material and construction than is common.

As a guide to the workman to show when the lamp is "home," a mark on the cord is usually sufficient to supplement the information given by the feel of the winch handle. For those who desire a more sensitive signal, a lever is fitted which is actuated by the pulley axle. The position of this lever is, therefore, an index of the stress on the cord. When the lamp top begins to press on the cushion spring in the contact box, the cord stress suffices to pull over the attached lever sufficiently far to ring a small alarm bell. In the figure this bell is shown attached to the handle which the workman carries about with him from post to post.

When detachable contacts are used, the workman can handle a lamp freely, knowing that there is no risk of current being on. It is hardly necessary to provide any device for ascertaining whether all connections are good after the lamp is pulled up: but a tiny portable electric bell or detector set, with a yard of "twin flexible" terminating in contact points, can be used to ring through the lamp circuit from the upper switch terminals when the switch is "off."

The whole set of gear can, when desired, be constructed in a yet simpler and cheaper form, and a simple attachment is sometimes added to ensure that the lamp rods are in uniform position relative to the line of the street.

With the great increase in the number of arc lamps now in use, station engineers everywhere are longing for the day when they can get rid of the present slow and expensive methods of lamp trimming. The advent in the market of so good a contact gear as that described gives promise of welcome relief from some of the troubles of street lighting.

TECHNICAL EDUCATION: ITS MONEY VALUE.

By A UNIVERSITY LECTURER.

In a recent issue of the Electrical Review there appeared an interesting diagram showing the value of a good technical education to the American youth. Almost simultaneously a reliable educational expert in England published some telling figures. An uneducated child, in this age of competition, has one chance in 150,000 of attaining distinction as a factor in the progress of the age. A common school education increases his chance about four times; an education at a high school gives the child eighty-three times the chance of his less fortunate and uneducated rival in the battle of life. A college education increases the chance of the high school boy nine times, thus giving him eight hundred times the chance of the untrained. So much for the general chances of success in the various walks of life.

There is a common superstition among people who have but little to do with educational affairs, that "genius will always shine," and that, whatever the obstacles placed in the path of the really clever youths, they will always of themselves forge ahead. But there was never a greater fallacy. Genius, and even cleverness, is a hot-house plant that requires culture and protection. It can seldom survive a struggle for the bare necessaries of life. The drain of an active mentality, if insufficiently supported by careful attention to the body,

will tell a sad and pitiful story, and oftentimes a bright lad loses the chance of his lifetime because his people cannot afford to keep him at College.

Here is a case in point. At a certain University in Great Britain, there were two engineering students. They worked side by side for two years ; A was first of his year in many subjects, B was always second, except in the few subjects in which he proved that he was a better student than A. And at the end of the two years' arduous, but never irksome, work, both A and B came with long faces to a lecturer, and told him that they must both go out into the world and earn their own living. But the lecturer was sad, for he saw in these two engineers-that-were-to-be two good men. And he told the pitiful story to his chief, who was also sorry, but did not quite see what to do. There were no scholarships for which the youths were eligible, although at the technical school in the same city there had been spent something like £100,000 by the City Council, who had provided no scholarships for the University. Now the lecturer consulted his fellow lecturers and demonstrators, all of whom were earning, perhaps, one-fifth of the salary of the Professor. But, although they, too, were immersed in research work, yet they were very sympathetic with those who struggled hard to learn, for their own paths had been none too smooth. And so these few put aside, maybe, one-tenth of their yearly income in order that the fees of either A or B for a third year might be paid. And they argued it out, at length, that B, who was less clever than A, should have the advantage. And they obtained for A a post at 30s. a week after his two years' training at a university and his two years' shop experience, and in four years A is worth about double that salary ; so says his employer. But that same employer had B to work for him (after his three years at a university) on higher class work such as testing, and B has done splendidly, earning at present more than twice A's salary. For the employer selected B because of his greater knowledge.

There is a still sadder aspect. A is compelled to do routine work, B has full scope for his originality. They have taken two different paths now ; A will never catch up to B. And yet A went to evening technical schools—he tells me that he used to almost fall asleep sometimes—and has honestly done his best.

It is only in recent years that there has been any real provision for training engineers outside of the Admiralty training schools ; and the money value of their education to those students who were fortunate enough to pass through the Royal School of Naval Architecture is apparent, for we find them holding some of the most responsible positions in engineering work. About 15 months ago, Mr. Alfred Morcom approached some of the old students of this school with the idea of meeting each other, if only for an evening. And what a gathering that was ! How it showed the money value of the education of these men. Take a few of the names of those present :—Sir William White, Sir Nathaniel Barnaby, Sir E. J. Reed, Phillip Watts, Esq., F.R.S. (Director of Naval Construction), Sir John Durston, Prof. Elgar (of Fairfield Shipbuilding Works), Mr. Pratten (manager of Harland & Wolff), Mr. Seaton (late of Earle's Shipbuilding Yard), Mr. Alfred Morcom (of high-speed engine fame), Mr. Milton (chief engineer-surveyor to Lloyd's), and several others equally well known. How Prof. Unwin must have felt a pardonable pride as he looked round upon his old pupils who were there before him to show the value of an engineering education.

Few people connect the sudden rise of Japan with such a secondary subject as education. But that famous statesman, the Marquis Ito, says that the success of the fleet and the army has been almost entirely due to the college which he was instrumental in founding some years ago in Japan. It is now the university of Tokio. Even our own Admiralty acknowledge that it is upon the mechanical training of the officers and men, rather than the number of ships, that the efficiency of the navy depends. Napoleon used to say, " In war men are nothing—a man is everything," and we all know of his ceaseless training in military affairs. In an engineering works the trained man is everything—the other men are machines.

There is, fortunately for English engineers, a wave of feeling in favour of better colleges and training grounds for the younger generation of our profession. Quite lately the writer was in Birmingham, and saw how lavishly they have spent money for applied science. Prof. Turner, in the Metallurgical Section, told him how one building with its equipment for his work (there will be other metallurgical laboratories) cost £10,000, and they told me in the Midland city that there would be spent, for applied science only, nearly half a million pounds sterling, in five or six years. It is a good investment. Ask the people in Manchester whether the School of Technology has done the city any good. In a few years you will know of the good work which the London Polytechnics and Colleges are doing. For of all these places " by their fruits shall ye know them."

THE RULES FOR THE USE OF ELECTRICITY IN MINES.

In a paper read before the Institution of Mining Engineers, at the London meeting of that body in June last, Mr. S. F. Walker criticises the special rules proposed by the Departmental Committee, which made the inquiry into the use of electricity in mines ; and he submits a draft of " a few simple rules which he suggests will meet the objects the Committee had in view."

Those who have had an opportunity of examining the proposed special rules contained in the report will—to some extent—no doubt agree with Mr. Walker, " that the liberal sentiments expressed in the report, and the practical line taken in the inquiry, appear to have taken a second place " in the proposed special rules. It should not be forgotten, however, that the task of the Committee was one of special difficulty ; and that the compiler of the rules, in all probability, had little or no knowledge of mining engineering, and made the well-intentioned mistake of trying to provide against every contingency, without knowing or considering whether such provisions were either suitable or necessary. The Committee had also to consider the interest of the " miner," who was beginning to look upon the use of electricity as an added danger, and its object, no doubt, was to draft rules which would tend to reassure him that there would, or should, be no danger from this source, and at the same time not to put any harmful restrictions upon its use. Hence it was in an unenviable position, and whilst it practically apologises for the length of the rules, yet it states that the subject could not be effectively dealt with in any other way.

Mr. Walker, however, sweeps away the whole of the rules suggested by the Committee, and submits in their stead a condensed set of six more or less general rules, which contain no hard and fast regulations, but leave everything, it would appear, to the judgement and decision of H.M. Inspectors of Mines. But with all due respect to H.M. Inspectors—who have had no regular electrical training—are they capable of judging ? An inspector of mines receives the same training as a colliery manager, and, in the first instance, is required to pass the same competency examination. Why then should the inspector have power to decide questions in electrical engineering practice, whilst the colliery manager must, as is suggested, be advised by an electrical engineer, who is not to have any responsibility ? It is not always that the colliery manager and H.M. Inspector agree upon mining matters, in which both have had special training, and, in fact, are experts, consequently it is fair to assume that there would be endless dissensions on questions of electrical practice in which neither has had the necessary training to enable him to form a decisive opinion.

As to the position of the colliery electrical engineer, Mr. Walker says, " The electrical engineer at the colliery must be responsible for all the electrical apparatus at the colliery to the colliery manager, just as the mechanical engineer is and must be supreme in his own department, subject to the over-riding authority of the colliery manager and H.M. Inspector of Mines." This sounds very like a " bull," for how can the electrical engineer be supreme in his own department if he is to be subject to the over-riding authority of the colliery manager ? One might as well expect the engi-

neer in charge of the machinery on board a steamship to be subject to the over-riding authority of the captain. It is true the marine engineer is under the orders of the captain, but in everything connected with his department he is responsible—not to the captain—but to the owners of the ship. The mechanical engineer of a colliery is not supreme, he is not in the least recognised, and at many collieries there is no mechanical engineer at all, the colliery manager—since he has to take the responsibility—taking the duties of the mechanical engineer himself. Hence it is that colliery managers have turned their attention more and more to mechanical and electrical engineering, to enable them to dispense with the services of either mechanical or electrical engineers, and the serious view of the question is: In doing so, are they not neglecting their underground training, and becoming, so to speak, "worse pitmen?"

Mr. Walker goes on: "For large firms, the best man to be found would be a mining engineer who had qualified in electricity and mechanics." But this is just what the colliery manager is supposed to be! The only point is—which Mr. Walker does not attempt to discuss—what should the qualification in electricity and mechanics consist of? Five years' underground experience, with such information as he can gather from the electrical and mechanical plant he sees about the colliery, with a more or less desultory reading of text-books? or a thorough training in mechanical and electrical engineering workshops and collieries? We previously dealt with this question in the leading article of our issue of August 28th, 1903, entitled "Colliery Managers and Electricity," and since then we have seen no reason to modify our views, but rather—with the increasing introduction of machinery in mines—to strengthen them.

So long as the use and management of electricity in mines is to be in the hands of those who have not received any special training in electrical engineering, it is only right and proper that stringent rules should be enforced for the guidance of those who are responsible, and for the safety of those who work under their instructions. Some of the rules proposed by the Committee are unnecessary, and in some cases—as, for instance, those relating to earthing, armoured cables, and running cables in iron pipes—their advisability is to be seriously questioned. Apart from these, however, they probably contain nothing but what would be included in a first-class specification, by a competent engineer versed in colliery conditions. Certainly the rules suggested by Mr. Walker do not appear to be sufficient for this purpose. For instance, Rule (4) states that:—"All electrical apparatus in use at a mine shall be so fixed and maintained that in the ordinary working of the mine (*a*) no part of the apparatus shall become unduly heated; (*b*) no arc shall be formed in any part of the apparatus; and (*c*) it shall not be possible for those using or engaged in the use of the apparatus to get a shock while carrying out their duties in a proper manner," which, to say the least, is very vague. What, for instance, is the colliery manager to understand by "unduly heated"? The author explains as follows:—The provision that no part of an electrical apparatus shall be unduly heated is, it will be seen, very far-reaching. To ensure that this is so, the engineer must follow certain rules with regard to the density of current in the cables, the insulation of the cables, the size and arrangement of the switches, fuses and junctions, and the size and insulation of the conductors in the generators, motors, &c. Quite so! But Mr. Walker assumes that the plant will be designed or built to the specification of a qualified engineer, acquainted with the conditions under which the plant is to work—and this he has no right to assume. There is nothing to prevent the colliery manager buying electrical plant in the open market to his own satisfaction, and to no specification at all. Again, "The third section (*c*) of the proposed fourth rule again embodies all that runs through the report of the Committee and their special rules; but it throws upon the colliery officials the onus of providing efficient means of carrying out the rule." This, however, is not enough; it might be if the rule applied to a certificated colliery electrical engineer, who would be held responsible and recognised by law, but not to the colliery manager, who is not supposed to have had an electrical training.

Generally speaking, what is wanted is some standard of excellence and quality which will be met by certain tests and specified temperature limits; some definite instructions to render the likelihood of accidents more remote, to guide the colliery manager in the selection, installing, and working of electrical machinery. So far as Mr. Walker's rules go, he might just as well, and with much less trouble, have condensed his six rules into one only, thus:—Special Rule.—There shall be no accident in any shape or form whatever resulting from the use of electricity in or about the colliery or mine. This, whilst leaving to the colliery manager full liberty in the selection, installing and working of electrical plant places the onus upon him of taking such means as will prevent accidents, and this, in a nutshell, is what Mr. Walker appears to be driving at. If the law enforces regulations regarding mechanical and electrical engineering, then let it recognise the colliery mechanical and electrical engineers as professional men, thus raising their status to the advantage of the mining industry in particular, and of the country generally.

OUR LEGAL QUERY COLUMN.

[Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.]

"Long Acre" writes:—"We are a firm lighted by our own electricity, and have received power from the Urban Council to take a wire across the street for the purpose of lighting up another shop of ours. Following upon this, we have received two applications from neighbouring people to light up their premises. Can we do this without Parliamentary power? Thanking you in anticipation of your reply through the paper above quoted."

*** "Long Acre" need not obtain any Parliamentary powers in order to supply his neighbours with electricity. If the neighbours in question live on his side of the street, he can lay the requisite mains and give the supply without even consulting the Urban Council, provided he obtains the wayleaves from private owners across whose premises it may be necessary to lay mains. If, on the other hand, the prospective consumers' premises are so situated that he will have to lay mains across streets, he should make the necessary application to the Urban Council. He would also do well to consult the Board of Trade regulations relating to overhead wires, a *précis* of which was published in the Electrical Review, September 9th, 1904, at p. 439.

"Farad" writes:—"What are the Board of Trade rules respecting the supply of current to a building which is in a London Supply Co.'s area, but about a quarter of a mile away from their nearest mains? We are under the impression that they are compelled to supply current to any building within their area, provided the installation reaches a certain number of lamps."

*** It is true that under the provisions of the Electric Lighting (Clauses) Act, 1899, undertakers are bound to supply current to all consumers within their district, but this does not compel them to lay all the necessary leads from the mains at their own expense. The Act requires that they must provide the leads for 60 ft., but consumers whose premises are beyond that distance must enter into a contract to take such a supply as will recoup the company in respect of the capital necessary to provide the special lead. The statutory regulations on the subject are explicitly set out in the schedule to the Electric Lighting (Clauses) Act, 1899, which will be found printed in Mr. Shiress Will's book on "The Law Relating to Electricity." It may also be had from the King's printers for a small sum.

"Contractor" writes:—"An estimate given by a contractor, B, was accepted by an architect for electrical lighting. A few months afterwards, before any work was done, A (the employer)* proposed a new scheme of lighting the building, then the contractor made plans which were accepted, but no estimate was given.

"1. Can B charge for the work as a new installation altogether, or as an extra on the old estimate? The new scheme altered the old estimate considerably.

"2. Can B charge a certain amount for plans owing to the new scheme?

"3. The contractor was delayed many months; he had men on the works, and he could not finish his work through A's fault. Can he make a claim for delay?

"4. Fittings were supplied by A. Nearly four months elapsed before B could get them to finish his work, and a delay of two

* It is assumed that A is the employer or building owner.—Eds. E.R.

months took place from the first delivery of fittings to the last. A bought them for about £200.

"Can B ask for a percentage on the fittings (for which there was so much delay in the delivery)? This not as delay but as profit."

*** With reference to the first question put by "Contractor," it is conceived that he is entitled to charge upon the basis of the old estimate, as modified at the request of the employer, which may be regarded as "extras." The price of the alterations will, doubtless, be fixed upon what is known to lawyers as a *quantum meruit*, and this whether or no they can be regarded technically as "extras" or no. The majority of contracts provide that the architect shall "sign up" for extras. "Contractor" will, therefore, do well to consult the architect, but even if the architect refuses to treat the alterations as extras, an action could still be brought upon a *quantum meruit*.

With reference to the second question, a reasonable charge can certainly be made for plans.

As to 3, if "Contractor" can show that he has suffered loss through his being delayed on the job, he could make a claim for damages. As to 4, there is no rule of law which would place any obligation upon A to pay the percentage in question. If B could show that delay was caused by the non-delivery of fittings, and that he suffered damage, he could claim that damage, but it would be extraordinary if he could claim a percentage, *unless*, of course, there was some express term to that effect in the agreement between the parties.

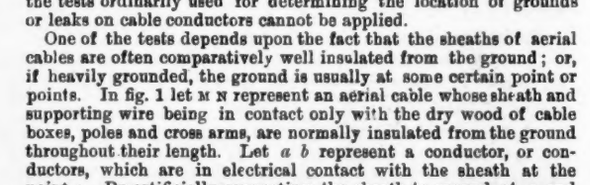
METHODS OF LOCALISING FAULTS IN TELEPHONE CABLES.*

By H. B STABLER.

The two methods which it is the purpose of this article to describe were designed to meet the requirements of certain cases in which the tests ordinarily used for determining the location of grounds or leaks on cable conductors cannot be applied.

One of the tests depends upon the fact that the sheaths of aerial cables are often comparatively well insulated from the ground; or, if heavily grounded, the ground is usually at some certain point or points. In fig. 1 let M N represent an aerial cable whose sheath and supporting wire being in contact only with the dry wood of cable boxes, poles and cross arms, are normally insulated from the ground throughout their length. Let *a b* represent a conductor, or conductors, which are in electrical contact with the sheath at the point *e*. By artificially connecting the sheath to ground at *g*, and connecting a battery as shown at *a*, a current can be made to pass through the conductors from *a* to *e*, and through the sheath from *e* to *g*. By applying the terminals of a sensitive galvanometer, such as a millivoltmeter, to two points, *r* and *s*, a few feet apart on the sheath of the cable between *g* and *e*, the presence and direction of this current will be indicated by a deflection of the needle. By repeating the test at other points on the cable, the point *e*, where the current first reaches the sheath from the conductors, can

Fig. 1.



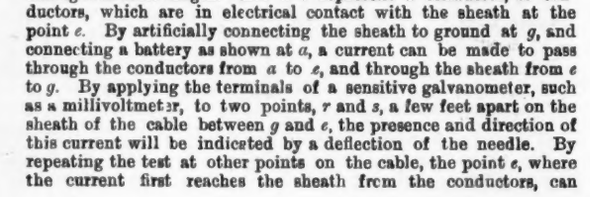


Fig. 2.

obviously be located, since between any two points, *r'* and *s'*, situated beyond the point *e*, there will be no current flowing, and therefore no difference of potential and no deflection of the galvanometer. If the cable sheath should be already grounded at two or more points, the test is still applicable. It is clear from the figure that with grounds at both *g* and *g'* the point *e* can be exactly located, not by the absence of deflections at points beyond *e*, but by deflections at points between *e* and *g'* in the opposite direction to those obtained at points between *g* and *e*, as any current passing from the conductors to the sheath at *e* will evidently divide, and a part of it flow in each direction from *e* to the ground.

Of course, this method fails in cases where there is a high resistance in the cross between the conductors and the sheath, as in such cases it is impracticable to get a large enough current through the circuit to give the desired deflections. The amount of current required is, however, not very great. For instance, with a cable sheath whose resistance is 0·1 ohm per 1,000 *ft.*, or about the same as No. 0 B. & S. gauge copper wire, the difference of potential between two points on its surface 4 ft. apart will be 0·1 millivolt if it is carrying a current of 0·25 ampere. In a central energy telephone system such a current may often be fed from the central office through cable conductors to the desired point, in order to save the party engaged in making the test the trouble of transporting a suitable battery to the end of the aerial cable. Indeed, it is probable that, in some cases, enough current to make the test may be found to be already supplied to the cable sheath from central energy subscribers' lines within the cable.

The foregoing method would also evidently fail where the cable sheath was grounded at points each side of *e*, and there were already differences of potential, due to foreign causes, between these points.

For the underground cable of a central energy system it is proposed, when all conductors have become impaired, to use a simple test, dependent upon the fact that in such cases there can usually be found idle conductors in the cable between which there is a small but appreciable difference of potential. Since one conductor of each working pair connects with the + pole of the central office battery, and the other conductor with the — pole, the above-mentioned condition is almost certain to exist; that is, there will be some conductors which, at the point where the insulation is moistened or soaked, will be in better electrical connection with the + working conductors than with the —, and some others that will be in better connection with the — than with the +. The proposed test, as originally conceived, consisted in taking, on two such conductors, simultaneous current readings with milliammeters at the two ends of the cable, and deducing from these the ratio of the two resistances, and therefore of the two distances, from the ends of the cable to the fault; the fault being regarded as a source of E.M.F. which causes current to flow through the two branches of the circuit in parallel. The millivoltmeter being an instrument in much more common use than the milliammeter, the substitution of it for the latter at once suggests itself as the first step towards simplifying the method and bringing it more within the reach of the practical cable tester. In fig. 2 suppose *a b* and *c d* to be two conductors in the cable, M N, defective at *e*, and V and V' two millivoltmeters of known resistances, *r* and *r'*, and connected as shown. Let C and C' be, respectively, the currents flowing through the two branches of the circuit, due to a difference of potential, E, between the conductors at *e*; D and D' the deflections in volts, of the two instruments, and R and R' the resistances of the cable conductors in the two branches; that is, R = the sum of the resistances of *a e* and *c e*, and R' = the sum of the resistances of *e b* and *e d*.

C and C' are obtained at once as the quotients of $\frac{D}{r}$ and $\frac{D'}{r'}$, and since $C = \frac{E}{R + r}$, and $C' = \frac{E}{R' + r'}$, we have, by eliminating E:

$$\frac{C}{C'} = \frac{R' + r'}{R + r}. \qquad (1)$$

The method presupposes that the length and gauge, and, therefore, the resistance of the conductors, is known. So by putting the equation in the form

$$\frac{C + C'}{C'} = \frac{R' + r' + R + r}{R + r}, \qquad (2)$$

or

$$R = \frac{C'(R + R' + r + r')}{C + C'} - r, \qquad (3)$$

we very readily obtain a numerical value for R, since C, C', *r* and *r'* are all known quantities, and (R + R') is also known, being the total resistance of the pair of conductors. It only remains to reduce the numerical quantity, R, from ohms to feet, and one-half of the result will be the required distance, *a e*, from the end of the cable at M to the fault.

If in the application of this method it is not possible, with the instruments at hand, to obtain deflections great enough to be read with a fair degree of accuracy, the test evidently fails. If, on the other hand, the difference of potential between the conductors under test is so great as to give more than a full scale deflection of the millivoltmeter, the difficulty can be overcome by shunting the meter with a suitable known resistance. If C is the total current in amperes passing through the meter and the shunt, R the joint resistance of the meter and the shunt, and D the deflection in volts, $C = \frac{D}{R}$, and $R = \frac{m s}{m + s}$, where *m* is the resistance of the meter and *s* that of the shunt.

In conclusion, I would remark that the application of this method could probably be extended so as to include cables other than those of a central energy telephone system; that is, cables not already containing any "live" wires—by simply temporarily connecting some of the conductors at one end of the cable to the two poles of a suitable battery or other source of E.M.F. in order to produce artificially the conditions existing in cables of a central energy system.

* Abstract from the *Electrical World and Engineer*.

APPLICATION OF ELECTRICITY TO STEAM RAILROADS.

A paper with this title was read before the Richmond Railway Club in May, 1904, and is reprinted in the American *Electrical Review* for August 13th. It was out of date when read, for the author, Mr. L. S. Randolph, speaks of alternating current on the trolley wire as impracticable in the present state of invention, ignoring the work which has been done in the last two years, which is sufficient at least to have deserved more than dismissal in the sentence:—"This system can hardly be said to be sufficiently promising to warrant consideration, except for light trolley service." The writer

was considering the application of electricity to main steam lines; but he was not judicious to give such a cold shoulder to alternating systems as a whole, especially when he must be aware of the "extensive experiments," if you will, which have been inaugurated for quite a long time as time goes now in engineering matters.

When stating the advantages pertaining to steam as against those gained by electrical methods, the author puts first:—"Separate units, one of which failing does not cripple the system or a section of the system"; and second, "that units can be put out of, or into, service as readily as the traffic demands, and that the capacity of a steam line can be increased (he speaks of doubling) simply by ordering enough locomotives, while the extension of an electric line is a slower business, as the capacity of the power houses and feeders has to be increased in addition to the rolling stock." Both these advantages vanish on even superficial examination; the first, because it is evident to anyone who knows the first thing about modern electric traction, that the multiple unit train is more flexible than a steam train in the ratio of motor cars to locomotives, while the power stations and the transmission distributing systems are so designed that nothing short of a catastrophe could hang up a section, at any rate, for longer than a steam section would be blocked by the breakdown of a train. It does not seem worth while to knock down the second advantage, for such a large addition to the capacity of a line as to out-load generating stations and feeders, never would be planned, much less carried out, in such double-quick time as to find the necessary extensions in every respect unready. For normal and foreseen extensions of service the electric line will be at least not second to the steam line in this matter of easy and speedy extension.

The third and last advantage claimed for steam traction is simply the old question of reliability. Each motor unit being entirely self-contained, depends only on the permanence of the track—which is common to both systems—to keep running. On paper, this advantage may be of more or less value, according as the penman is an advocate of one or the other system. That there is a potential advantage is clear, but we feel sure that it is of only the slightest practical importance, for the reasons given above.

The advantages detailed by the author for electric traction are much more numerous and less open to criticism, although the following might have been omitted without damaging the prospects of electricity:—

"Where the path of the return current is from the driver to the rails, a considerable increase in tractive effort is obtained above that due to the weight alone. This amount is not definitely known."

The author makes two allusions to the possibility of turbines being employed as steam motors on locomotives, but few can share his hopes.

Further on, when beginning a commercial comparison, he says that it would be "entirely impracticable to attempt to run a motor with one man alone unless the other members of train crew had access to him." It may not be allowed by the authorities, but recent refinements in apparatus for operating the multiple-control system have quite discounted this statement. Driving has become a matter of keeping a lookout for signals and stations, for the actual handling of the apparatus to produce or reduce motion has been removed almost from the personal influence of the driver.

The financial comparison is, and is intended to be, but rough, and it is not possible to say whether the generating system for which the estimates are drawn is direct current, with booster sub-stations, or alternating, with converter sub-stations, for both are mentioned.

It is hardly worth while attempting a criticism of the figures produced by Mr. Randolph, as his fundamental assumptions are open to argument, and are not quite broad enough for the purpose of the paper, which is to prove that electricity is not at present in the position to oust steam for anything like main line service.

Although the paper is too superficial to attract the attention of electrical engineers as a whole, it may be recommended to those among us whose prophetic vision sees no steam engines on any railway ten years hence. It may help them in the direction of modesty.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Unfair Competition.

In answer to "Educated Mechanic" and others, may I say a few words on the other side? First, I have no sympathy with the "willing to work for nothing man;" and I do not think, in the long run, he derives any real advantage from his cheap tuition or experience. But, with regard to the second cry, let me here say that the attitude of employers, condemned by your correspondents, is largely due to applicants themselves. From some dozens of advertisements issued by me during the past seven years for wiremen, as well as for engineers for responsible positions, I have received hundreds of replies, and I would tell "Educated Mechanic" and others that if they confined their applications for a post to as few words as possible, merely stating their suitability for that post, and supporting their claims by one or two copies of good testimonials, they would stand a chance. Nothing is more trying than to advertise for, say, a wireman, and receive, as I have, a letter consisting of four closely written pages of foolscap, dealing with everything that the man has done, or learnt since leaving school. It is not wanted, it is tedious reading, and it is invariably fatal to that man's chances. It would have been far better had he just said, briefly, that he had been wiring so long, had just left so-and-so, could start at once, and wanted so much.

Suppose I advertise for an engineer to take charge of a branch business. The duties, which are responsible, consist broadly of getting wiring work, seeing it done, and making it pay. Is it, then, of any interest to me to know that a certain applicant was so many years on a P. and O. boat, then had charge of a colliery, and knows a good deal about wireless telegraphy?

Another thing; many men, perfectly eligible, throw away all hope of success by an abominable—I can call it nothing else—subserviency in their letters. Most employers want men, not worms. Why begin "Honoured Sir," or similar rubbish, and go on to add, "if you favour me by giving me this appointment, it will be the aim of my life to reward your great kindness, &c.," and finish with "I remain, your obedient servant"? When you've got the job, to put it in plain English, you'll get the chuck if you don't work. You know it, and the employer knows it, and so don't slime.

Another thing. Preserve me from the workman who has "some education" and talks about "being intellectually smarter," and rot of that kind. Become as educated as you can, and remain a little modest with it. If a jointer is wanted, it *is* a jointer, and the best jointer ought to get the job, even if he cannot write, though you can read Virgil without a crib. When work is in the market, come in on work, and show your intellectual superiority by laying low, until you see a chance where brain can get a grip, and then grip. Don't waste brains all over the place—they're scarce. And also remember that the next man to you may have more education, or a quicker grasp than you have, and yet not hang it out for admiration.

Again, what use is your education to a master? He values smartness (intellectual goods, smartness is, and worth a lot of Euclid) and ability—not ability to read German, or to talk about Hero of Alexandria—but ability to bring out a job on the right side in a high-class style. He has no use for your education. You are the man to use that. And the time will come when it will be of use, no doubt; but if you talk about it, and sicken people, who may have as much as you (it is not probable, I know, but it's possible), you will find it undoubtedly "enough for him (a manager) to throw you out." And if you haven't any more sense, you deserve it.

Geo. Barham,
Engineer and Manager,
Crampton, Oliver & Co.

Bury St. Edmunds, *September 10th*, 1904.

A Query from New Zealand.

I should esteem it a favour if I could be supplied through the medium of your journal with the name and address of the makers of the Thunderbolt Governor as applied to the engines of Liverpool Overhead Railway, and as described in your issue of October 29th, 1897. Is this system of governing continuing to give satisfaction? Can any of your readers who have had experience of this system oblige?

15-year Colonial Reader.

[We understand that the Thunderbolt Patent Governor Co., Ltd., of Kelvinbridge, Glasgow, is now winding up with Mr. G. B. Nancarrow (W. B. Peat & Co., of Middlesbrough) as liquidator. But if any of our readers has any information of value relating to the working of the governor, we shall be pleased to hear from him.—Eds. E.R.]

Information Wanted.—A correspondent requires the names of the makers of lace chain for arc lamps.

REVIEWS.

Starters and Regulators for Electric Motors and Generators. By Rudolf Krause. Translated by C. Kinzbrunner and N. West. London: Harper & Bros. 4s. 6d. net.

Whilst there are several points of interest in this book, we cannot say that it altogether satisfies the need there is for a good work on this subject. The first two chapters dealing with general principles of circuit breakers and circuit breaking have no special application to starting and regulating switches, although in themselves the chapters are not without interest. Being the work of a German, the data given refer in great part to German practice, which does not always coincide with the conditions obtaining in this country. As regards the question of temperature rise, for instance, the author assumes in his calculations that the resistance material may rise as high as 200° C., whereas according to existing rules in this country 240° F. is the limiting rise of temperature allowed.

The theory of starters is gone into at some length, and will be interesting to students and to those engaged in this particular branch of the industry, and the same applies, of course, to the chapter on mechanical construction of starters.

Whilst the book forms an interesting addition to the literature on the subject of starting and regulating apparatus, there is still the need, we think, for a book dealing with the subject from the point of view of English practice.

We might add a word of commendation to the translators, who have done their part of the work well.

Electrical Motor Installations. By F. J. A. Matthews. Manchester: The Scientific Publishing Co. 2s. 6d. net.

This book is intended by the author for factory-owners and other users of steam power, and consists in the main of descriptions of the various apparatus used in electrical motor work, together with descriptions of actual motor installations.

The first two chapters dealing with the advantages of electrical transmission, and "definitions and functions" are clearly written, and in a way that any business man accustomed to dealing with figures and technical matters generally can understand. The two following chapters on types of British motors, starting switches, and accessories are fairly comprehensive, illustrations and descriptions being given of most of the best known motors and switches in use. On page 42 an illustration is given of a gas engine alongside a motor of the same power. The illustration shows forcibly the great saving of space that is effected by the adoption of electric motors. The chapter on starting switches, &c., is probably the best chapter in the book, and is, we should think, the best general description of this type of apparatus that has yet been compiled. Not less interesting is the chapter on devices for speed variation, in which considerable space is taken up with the systems adopted for newspaper press work, in which the speed variation required is very wide. Some definition of the word "teazer" appears to be necessary, as the author uses this to describe any small motor that is used as an auxiliary to a larger motor. We do not quite think that this was the intention of the originators of this expression.

A special chapter is devoted to the application of motors in colliery work, the bulk of the chapter being taken up by the work of one well-known firm.

The descriptions of existing motor installations will probably be the chapter of greatest interest to the general motor user, and for this reason it might with advantage have been somewhat more comprehensive. Whilst, perhaps, it is too much to expect that the names of contractors should be suppressed in the text, this part of the book resolves itself into an advertisement for the few firms whose names are mentioned. Many of the descriptions are obviously furnished by the contractors, their figures being accepted without any criticism. In fact, the author throughout does not express any decided opinions of his own, but contents himself with general descriptions of the work and apparatus. We note that one of the last installations described was installed under the supervision, and to the specification, of the chief engineer of the author's company, which, whilst originally and essentially an insurance company, also (we find from advertisements in the book) undertakes consulting work. When the Council of the Institution of Electrical Engineers revise their suggested rules for professional etiquette among consulting engineers, the questions of advertising, and the status of the consulting engineer might be with advantage more fully considered.

The last section of the book is devoted to "Attention and Maintenance," and the only exception we could take to it is that in more than one place it is used as an advertisement for the author's firm, and, in fact, concludes by recommending works owners to insure their dynamos and motors with the company referred to. It is noticeable that the illustration of the motor used on the installation supervised by the author's chief is of French make, and is almost the only two-pole open-type motor shown in the book. There is one other which is of American make, and it is almost unnecessary to say that this is a type of motor which would be rarely permitted by any fire insurance company.

The index is somewhat badly arranged, as it is not possible to find from it a description of an installation in any particular class of work. For instance, although there is in the book a description of an installation in a biscuit works, this could not be found under the letter "B"; neither can a colliery installation be found under "C"; nor printing works nor paper mills under "P," and so on. It is necessary to look through installations under letter "I," and even then one gets no idea in most cases as to the class of the installation. Thus, under "I" we find "Installation, Baker's"; "Installation, King's"; "Installation, Thompson's," and so on, which gives the reader no information whatever as to the nature of the installation. In a future edition we should recommend the author to remodel this part of the book, as a book with a poor index is robbed of at least half its value.

Oil Engines. By A. H. Goldingham. London: E. and F. N. Spon. 1904.

This is an extremely useful work, not less valuable because it is confined to such engines as use heavy kerosene, Scotch paraffin, coal oil, or similar oils varying from 0·78 to 0·85 sp. gr., and flashing at 75° to 300° F.

The naphtha, or petrol engine, is regarded by the author as a gas engine proper, with the addition of a carburetter. The term oil engine is understood to apply only to such engines as use the oil itself directly in the cylinder. With these engines the author deals in considerable detail, showing how the fuel is introduced, how it is vaporised and ignited. He also deals with the Diesel engine, which, though usually fed with crude oil, is equally effective with any liquid combustible that can be pumped into its highly-heated compressed charge of pure air.

In addition to descriptions of various oil engines, there are chapters on the designing of engines, with a plea for simple construction, and the engineer will find a few examples of dimensions in this chapter, and various hints on knotty points, on testing engines, with notes on I.H.P. and B.H.P., and on indicator work, &c.

There is a chapter on the running of engines, one on repairs, and one on the faults and troubles met with. A general chapter on fuels is also given, and a final miscellaneous chapter.

The illustrations generally are good, and though set up and printed in America, it is not written in Americanese, nor spelt in the slovenly manner only too common there.

Dynamo Attendants and Their Dynamos. By Frank Broadbent. London: Rentell & Co. 1s. 6d. net.

This is really an excellent little (110-page) book, written in terse paragraphs, and with clear diagrams, and it should prove useful to students and artisans actually engaged in

electrical work. Mechanics and engineers in charge of machinery generally will also find much useful information regarding motors and motor driving.

The book is divided into 16 chapters, and if any fault is to be found, it is that the alternating current sections are not as fully dealt with as the direct current. No doubt, with the rapid growth of polyphase work, this will be rectified in a future edition.

In connection with belt driving from gas or oil engines, where the rotation is somewhat unsteady, the author points out that it is well to deviate from the usual rule of having the tight side of the belt at the bottom. He shows that, with the slack side at the bottom, then, at each impulse, the slack side slackens, and the tight side tightens, and as the dynamo resists sudden change in speed, the belt is pulled round the dynamo pulley, that is to say, it "slips." Placing a fly-wheel on the dynamo is no solution, for the fly-wheel should be on the engine.

Dealing with compound winding, the author says two-pole machines have usually half the series turns on one pole, and half on the other, the two sections being connected respectively between one brush and one main terminal. Dynamos intended to be run in parallel, however, must have all the turns connected in series between one brush and one terminal only. In many modern multipolar machines it is usual to place all the series turns on one set of poles (say the N-poles), because this simplifies the connections.

In referring to damp insulation, the author instances a case where some armature bars were short-circuited by reason of the letters of the purchaser's name having been painted on, and, unfortunately, the paint happened to be hygroscopic. Running a machine partly excited, and with the circuit switches closed, is recommended for drying out a new machine, or an old one which has been standing for some time.

The mistake of building small motors for high voltage and low speed is well shown by giving the windings for a 2-H.P. motor for 230 volts and 1,500 revolutions, and for the same carcase when wound as a ½-H.P. motor for 530 volts and 300 revolutions. The armature conductors are as 1,040 to 10,000, and the field turns 12,500 to 30,000. It is clear that with these higher numbers of windings there will not only be difficulty in winding the very fine wire necessary, but a large amount of insulation will also be required, which must considerably reduce the efficiency.

To show the very practical nature of the book, it may be mentioned that Chapter IX. deals with sparking at the brushes; localising a break, if not obvious; bedding the brushes; overheating of armatures and magnet coils; breaking of armature wires; heating of bearings; dynamo failing to generate; break in the circuit; polarity of dynamo reversed, &c.

Starting switches are very fully dealt with, and there are useful chapters on faults and breakdowns, and on spur gearing.

Subject List of Works on Electricity, Magnetism, and Electro-Technics in the Library of the Patent Office. London: The Patent Office, 25, Southampton Buildings, Chancery Lane, W.C. Price 6d.

This is one of the excellent series of bibliographies which are being published by the Patent Office Library. A general scheme of classification is given at the end of the volume, and the lists of works falling under each of the headings and sub-headings of this work are given in the main part of the volume, in which the said headings and sub-headings are arranged alphabetically. The works under each sub-division are arranged in chronological order, which will be a great advantage to anyone interested in the history of any special branch of electricity.

No system of classification can satisfy the requirements of everybody, but we think the classification in this little volume might have been made much more useful if there had been a little more repetition of the entries of books under different headings. For example, there is a great deal of valuable historical information about arc lamps in Dredge's volumes on electric illumination, but this work is not to be found under the heading "Electric Arc Lamps." A number of similar instances could be cited. We observe that a treatise on the Wehnelt break is entered under "Switches." No doubt, in a sense, a Wehnelt break is a switch, but most people would look for it under "Induction Coils," where information about other kinds of interrupters is to be found.

The Patent Office Library is one of the most complete technical libraries in Europe, and everything possible is done to make its contents easily accessible to the public. These handy little subject matter bibliographies represent one of the latest efforts in this direction. Their production is highly creditable to the library staff, and we have no doubt they will be greatly appreciated by the large body of readers who make use of the library.

The Diseases of Electrical Machinery. By Ernst Schulz. Edited with a Preface by S. P. Thompson, and translated by Hugh Ledward. London: E. & F. N. Spon. 2s. net.

Dr. S. P. Thompson's preface draws a comparison between the ailments of mankind and of the dynamo machine, and he uses the phrasing of the medical books in an amusing manner to describe the constitution of the dynamo. For example:—

"It is true that in the seventies he was a puny weakling, that in the early eighties he suffered from a sudden epidemic of the disease called flats; that owing to early mismanagement, he used not only often to run away, but even to burst his binding wires. His limbs were racked by want of proper balance, and occasionally a sudden high fever caused him to shuffle off a mortal coil or two."

It is interesting to note that whilst in the dynamo chapter there are plenty of faults to analyse and prescribe for, directly the author begins to deal with alternating current machinery his task is much simplified, and we find him saying at the end of the chapter on Induction Motors:—"From the above it follows that faults with polyphase motors are much rarer than with continuous current motors, as may be confirmed at any time by actual practice."

Again, when dealing with continuous current boosters, the author says that they should only be given into experienced and conscientious hands, whereas under alternate current transformers he says:—"Faults occur relatively much more rarely with transformers than with dynamos."

The modern alternating current generator and polyphase motor have indeed attained to an amazing robustness of constitution. The 84 pages of this little work have, however, many interesting little points on how not to do things, and to cure them when they are done wrong, which should make it useful to dynamo attendants and those engaged in the manufacture and testing of dynamo machinery.

The book is divided into four chapters, namely:—"Continuous Current Machines," "Single and Polyphase Generators," "Single and Polyphase Induction Motors," "Transformers," "Efficiency."

Carborundum paper is recommended as a means of grinding down hard mica when it projects above the segments, and the Boudreaux self-lubricating brushes are stated to be the best where metal brushes are necessary.

The curious fact that when a short circuit occurs in the armature coil of a motor, the machine shows a tendency to run slowly backward, is referred to. Also the importance of arranging the series turns of a compound-wound motor so that they assist the shunt when it is desired to increase the torque at full load.

The various methods of arranging starting switches for motors are fully gone into, the starter being arranged in series with the armature, whilst the shunt winding is connected parallel to the armature and the starter, so that at switching on the shunt stands under full pressure.

The mesh and star connections for three-phase generators are fully described, and diagrams are given showing the right and the wrong methods of connecting up the armature coils.

In referring to three-phase motors, it is pointed out that although most firms design their three-phase motors with star-connected stator windings, it happens that for 110 volt motors the stator windings are usually designed with mesh connections, for the reason that this same winding can then be reconnected with a star grouping at 190 volts.

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The danger of throwing the full pressure on motors when the starting switch is not on the zero contact is mentioned, but nothing is said of the no-load automatic starting switches which are now so common, nor yet of those fitted with over-load release.

THE FREE EXPORTATION OF SMOKELESS COAL.

Some interesting letters have been published in the *Times* lately, contesting the opinions so forcibly expressed on numerous occasions by Prof. Boyd Dawkins to the effect that certain steps should be taken to economise our stock of smokeless Welsh coal. Prof. Dawkins's views are too well known to need recapitulation; but it is perhaps desirable to mention the leading points of his argument, in order that we may see how his propositions are dealt with by his adversaries. Prof. Dawkins says that we possess the only seams of smokeless coal in Europe; that the use of smokeless coal means invisibility at sea; that invisibility may spell victory; and that, therefore, we should retain all that coal in our hands for the service of the Royal Navy ready for the next maritime war in which we may be engaged. Apart, too, from purely "smokeless" reasons, Welsh coal is more concentrated a fuel than its solid competitors, so that it gives even the merchantman a wider scope of activity. As voiced by Mr. J. Macaulay, who is general manager of the Alexandra (Newport and South Wales) Docks and Railway, the arguments on the other side are as follows:—That the value of invisibility is over-rated; that it is foolish to forgo a very real and obvious present advantage for the sake of a problematical future—since our general over-sea commerce (and not merely the coal trade) would suffer if we refrained from using smokeless coal; that by the time our seams are exhausted other nations will be in a similar position; and, moreover, before that time comes, other sources of energy will have been discovered which will have rendered the ship propelled by steam power a thing of the past.

The precise value of Welsh coal as a means of conferring comparative invisibility upon a ship in time of warfare is clearly a matter for the naval expert to decide; but its value as yielding a greater number of ship-nauts (if there be such a phrase) per ton or per cb. ft. is patent to everybody. The argument that since we possess the only mines of smokeless coal in Europe, we may safely allow other nations to help us to empty them in times of peace, seems a trifle dangerous, for we should have thought the geologist would hesitate before admitting that our Continent had already been exhaustively examined; while beyond this looms the perfectly insoluble question as to where, or under what flag, the other seams of smokeless coal which are, no doubt, to be discovered in extra-European parts of the earth may exist.

But in some respects these inquiries, like that into the approximate date when our own mines may be exhausted, would appear to be matters of detail beside two other questions. The first of these is whether it is really practicable to limit the present consumption of smokeless coal on the assumption that it does confer upon us invincibility at sea. There are so many of our fellow countrymen whose daily bread depends upon the Welsh coal trade, that the industry could only be restricted at the cost of much suffering; and it may be doubted whether any House of Commons could be found to pass the measures that would be required. The compensation that would have to be paid to the mine owners, and the sums of money that would have to be found to maintain the workmen and their families until new labour markets were created, would assuredly be voted insupportable by the already over-burdened tax-payer.

Manifestly, however, the need for such heroic procedure is entirely removed if there be any reasonable probability that by the time our Welsh mines are worked out, the marine steam engine—or rather coal as a source of locally developed energy on board ship—will have passed away. The internal combustion engine is already a serious rival to the steam boiler in the case of all small power units; and in every respect it would benefit the community were the former to be far more generally adopted. No engineer can have the least hesitation in endorsing the late Sir Frederick Bramwell's prophecy—if not his data—for the supersession of the steam engine by the explosion motor; but setting on one side the stationary inland motors fed with producer gas made from non-Welsh coal, the only fuel yet employed on the large scale is one which has not been discovered within the British Isles. It is not easy to see how we as subjects of the British Crown, and more particularly as inhabitants of the metropolitan country which provides the bulk of the money for Imperial purposes, can look forward with complacency to a time when our men-of-war and merchantmen shall consume petroleum oil derived from the wells of the United States or those of far-distant colonies.

We may freely admit that there is no reason why petroleum products should be regarded, as they are usually at present, as the only liquid fuels available in the explosion motor in countries where denatured alcohol is not cheap. The more volatile oils or spirits recovered by distillation from coal-tar, or even coal-tar itself, can be burned; and in measure as the use of gas firing spreads in factories, so more tar will be produced, which will tend to lower its price, unless a new market is found for it. Similar considerations to these, coupled with a desire to find a purely British fuel, have induced our contemporary, the *Autocar*, to study the possibility of consuming coal-tar benzol in motor-car engines; and, under suitable conditions, the spirit has behaved to admiration. This is but a small matter, yet it suggests that, with a gradually falling price, some descriptions of liquid fuel, derived from the coal gasified to yield energy in large power generating stations, may eventually prove possible of utilisation on shipboard.

Mr. Macaulay's anticipations, however, go much further than this, for he hopes the day may arrive before the Welsh seams are exhausted, when our merchantmen shall be propelled, and our fighting ships driven as well as operated, by energy stored on board in the form of electricity. He looks forward to the time when electricity works actuated by a fuel gas shall exist at dockyards and the like, where ships shall be "loaded" with energy by the coupling together of a few cable ends. The man of science who regards as final a process of obvious inefficiency, and refuses to see that improvements or radical changes are to be effected, takes a very unscientific attitude; but the man who in similar circumstances arranges for the abolition of an existing process by an almost fixed future date on the ground that a better method will have been evolved by then, appears to possess too much of the gambler's spirit to be a trustworthy guide. As the *Times* writer has done in the present connection, we smile, pityingly perhaps, at Nelson's desire that oaks should be systematically planted in order that we might have the material wherewith to build new wooden ships of the line; but had he dissuaded the country from doing this, and had the wood been needed, we should have held him up to obloquy.

On the whole, it would appear that far too much public money would have to be spent on an object of questionable necessity if the present virtually free trade in smokeless coal were to be interfered with. A small proportion of the sum, a very small proportion indeed, set aside for the financial assistance of accredited men of science who should investigate all methods of reducing the consumption of coal per horse-power in steam engines which still remain possible, all methods of checking waste of coal at the pit, the naval base, and the stoke-hold, all rival methods of developing power from coal; who should study all methods of developing power from more compact fuels with or without the use of gas as an intermediary, and all ideas for the production of an electric accumulator light in weight, small in size, and trustworthy in action—a comparatively small sum of money devoted to these purposes, we suggest, might produce farther reaching results than those which could possibly follow an adoption of Prof. Dawkins's plan, and might enable us to await the exhaustion of our Welsh coal measures with less concern than we feel at present, allowing our immediate descendants to abandon the local consumption of coal altogether, or so to improve its efficiency, that the remaining grades would last for an almost indefinite period.

MACHINERY BREAKDOWNS.

The customary annual report by Mr. Longridge, chief engineer of the Engine Boiler and Employers' Liability Association, has now been issued for last year, and is of its usual interesting and instructive order; it contains the customary detailed lists of accidents and of parts which failed, from which it can be gathered that valves and their gear occupy first place in the frequency with which they fail, followed by air pump motions, spur gear, cylinders, and chests, &c., among steam engines, while a not dissimilar order is observed for gas and oil engines.

Fractures from cracks starting at the corner of key ways continue to point to the weakness of such corners, and the danger of over driving the key. Various broken shafts failed with maximum stress of 7,500 to 8,700 lbs. per square inch, and made up to 235 million revolutions. One only made 51½ million turns, but there was a suspicion of a possible initial starting crack not more than a scratch.

Electrical machinery has cost more to inspect than was anticipated, especially in the smaller sizes, for which higher rates have had to be charged. Coal-cutter motors have failed in the ratio 1 to 2, and other underground motors are also very apt to fail. The minimum risk comes with the lighting machine, clean and well looked after in a dry room. A single burned armature conductor may mean the removal of every bit of the winding, and such machines as have these disadvantages are evidently to be penalised out of existence in due time. The order of number of breakdowns is armatures or rotors, stators, commutators, miscellaneous, switchgear; the armature of a dynamo is less safe than that of a motor in the ratio 62 to 50·5 per cent. of all breakdowns. Age and deterioration are the leading causes of breakdown in this class of machinery.

In one instance a set of coils, wound for 250 volts, had been put into a 500-volt machine, with great heating and sparking as a result.

Single wrapping of cotton tape for armature coils in slotted cores is condemned. Only one case of malicious damage occurred during the year.

Regarding boiler inspection, it is still found that boiler owners frequently make very poor preparation for the inspection of boilers, and inspectors have to spend much time in doing work that ought to be done by the boiler cleaner or sweep, and yet the inspectors, if they chose to do so, could make things very unpleasant for owners. The most serious defects are those of corrosion and grooving as regards number; but there were found 20 choked water gauges, 18 overloaded or inoperative safety valves, and 58 serious fractures.

On one occasion, by persisting in examining a boiler which was being corroded by damp flues, though they refused to grant a certificate, it appears likely that ultimate explosion was avoided, though, had an explosion occurred, it is quite probable, to judge by precedent, that the owner would have laid the blame on the insurance company because they continued to insure though refusing to certify to safety. Boiler owners will often run the gravest risks and make the meanest excuses when their boilers explode. We think it is in the public interest that insurance companies should continue to insure the dangerous boilers, though at the same time the refusal of the certificate of safety should perhaps, for the company's sake, be sent in a registered letter. In the case in point had the company refused for its own sake to insure the boiler, this would have gone on without the repeated warning of the inspector, and would ultimately have burst no doubt.

It also seems advisable that when, as in Example 3, an owner refuses to replace a bad boiler and it is too dangerous to insure, the insurance company should be compelled to notify the Board of Trade, and a special warning, pointing out the risk, should be sent to the owner. Such a notice would be of great help to the coroner's jury in rendering a verdict of manslaughter against the proper person. In the case of one exploded boiler, as the result of the formal investigation, the seller of a boiler was fined for selling a 35-year old patched boiler as fit for 40 lbs. pressure, the last owner for working the boiler without competent inspection, a cart builder for posing as a competent adviser to buy the boiler, and a boiler maker for posing as a competent person when he was not.

The one test recorded in the report is that of a Diesel engine using crude Texas oil at Ghent. The brake was not satisfactory, and the oil could only be measured on the I.H.P. The maximum recorded pressure was 525 lbs., and the mean pressure on the three pistons was 75·6 lbs., 88·3 lbs., and 98·8 lbs., using oil of 19,750 B.Th.U. calorific capacity by Berthelot-Mahler bomb, or 18,642 B.Th.U., after deducting for the water vapour. Owing to imperfect combustion, the oil at the first tests per I.H.P.-hour, was 0·412, 0·374, and 0·386. A second series of tests was made later, and gave much more regular mean pressures of 95·6 average, from which no cylinder varied much, and the oil per I.H.P.-hour was 0·3345 lb., a figure which almost exactly corresponds with a previously published test made on a two-cylinder engine by Mr. W. H. Booth, and does not differ far from figures found by Mr. Ade Clark. Mr. Longridge's figure for the thermal efficiency also closely corresponds with Mr. Booth's figures, being 42·8 calculated on the indicated horse-power, and the heat supplied to the engine on the assumption of perfect combustion.

The extreme regularity in the results of the Diesel engine is very remarkable, and serves to show that the system on which it works must be sound, and there must be great certainty of action and perfection of combustion.

Finally, it is to be noted that the insurance company is now known as the British Engine, Boiler, and Electrical Insurance Co., the Employers' Liability having been dropped from the company's business as inconsistent with "inspection guaranteed by insurance."

WRONGFUL DISMISSAL.

[BY OUR LEGAL CONTRIBUTOR.]

The summary dismissal of a servant or a clerk sometimes involves an employer in an action for wrongful dismissal. In some cases the dismissal may be justified, when no question arises as to the measure of damages; but in others the employer sometimes runs a risk of having to pay damages assessed upon a scale which is based upon a variety of considerations.

In general a master is entitled to dismiss his workman without notice under the following circumstances:—

1. When the servant unlawfully absents himself from work;
2. If he prove to be incompetent to perform any particular service which he agreed to render;
3. If he refuse or neglect to obey his master's reasonable orders; and
4. If he is guilty of any grossly immoral conduct, or of habitual neglect in the performance of his duties.

Save upon one of the above grounds, a master is not entitled to dismiss his servant without notice unless there is some special term to that effect in the contract. Assuming that a master does dismiss his servant without notice, the question remains: How are the damages to be assessed? In furnishing a correct answer to this question, we are greatly assisted by a case which was decided a short time ago in the King's Bench Division by Mr. Justice Kennedy, and to which we shall presently refer.

The general rule is that upon dismissal without notice the servant is entitled to full wages for the period during which notice ought to have been given, but he is not entitled to his full salary for the unexpired period of the contract of service, but that is to be reduced by the probabilities of his having other employment during such service, and it is the duty to make every workman to endeavour to procure employment elsewhere. Moreover, a servant cannot recover damages twice for wrongful dismissal, for he cannot by subsequently tendering his services recover for a continued refusal to employ him throughout the original time of service.

There are, however, certain other matters besides wages or salary which a jury are entitled to take into consideration in assessing damages for wrongful dismissal. In accordance with the well-known rule of law, that damages recoverable on a breach of contract must not be too remote, it is not competent for the plaintiff to point to all kinds of profits which he might have made had his employment continued. Nevertheless, it is allowable for him to show that if he had remained a servant certain gratuities or other benefits might have accrued to him, although the employer was under no express obligation in respect thereof. The following case is a favourable illustration of this principle.

The plaintiff had been engaged by the defendant to superintend some draining operations upon his estate at a salary of £2 per week and a house to live in, and he was also to receive a gift of £20 if he remained until Ladyday. Before the expiration of the term, the plaintiff was wrongfully dismissed, and was ordered to leave the house which the defendant had elected to put him into. In an action for wrongful dismissal, it was held that in assessing the damages the jury had a right to take into consideration the gift of £20, which the plaintiff would have earned had he been allowed to

do so. Here the receipt of £20 was practically certain; but in the recent case of Turner *v.* Sawdon & Co., contingent advantages of a much more shadowy nature were taken into consideration. The plaintiff had been employed by the defendants as traveller under an agreement which may be divided into three parts. By Clause 1 the defendants agreed to employ, and to continue to employ, the plaintiff for four years as from April 1st, 1898. The second clause provided for his remuneration, and the third set forth the various duties which the plaintiff undertook to fulfil. Disputes subsequently arose between the parties. Mr. Turner was not willing to accept the terms which the defendants were about to impose upon him, and they were not willing to accept certain terms which he sought to impose upon them.

Fearing that if they dismissed the plaintiff outright, his influence might tend to injure them elsewhere, the defendants in December, 1900, granted the plaintiff what they termed a holiday on full pay, but, in fact, they intended subject to some arrangement for settlement of matters in dispute being arrived at, not to allow him to act for them any more. In pursuance of this they wrote to their various customers, stating that the plaintiff was no longer authorised to act for them. He thereupon brought an action at the Leeds Assizes for breach of contract. Mr. Justice Kennedy left it to the jury to say whether upon the above facts, the defendants had fulfilled their part of the bargain. The jury having answered this question in the negative assessed the damages at half a year's salary. The case then came to London for further consideration, when it was argued on behalf of the defendants, that inasmuch as they had paid, and were willing to continue to pay, the plaintiff a salary at the rate at which he had been engaged, the fact that they gave him a continuous holiday was no breach of contract on their part. The learned judge, however, held that in what they had done they had been guilty of a breach of contract, he said:—

"The plaintiff undertook to devote his whole time to the defendants' interests. It is true that 'employment' in the strict sense of the term means taking into service, but it may also mean employment in a specified capacity, or to do work as the representative of a firm. In addition to the salary, an employé often obtains commercial advantages such as business experience, and contact with men. It seems to me that a man might accept a small salary, under certain circumstances, in order to gain these advantages. In this case it is admitted that the plaintiff was deprived of all occupation, and that other persons were employed to do his work. I think the jury arrived at a correct conclusion, and that the plaintiff is entitled to a verdict."

NAVAL BELL CIRCUITS.

Electric call bells are used in the Navy in conjunction with voice pipes or telephones, and are of two kinds, the ordinary tremble-bell, and the single stroke; the latter is occasionally used in connection with engine-room telegraphs, indicators for revolutions, and so on.

As far as possible, only one bell is used for each group of connections, and it works in conjunction with indicating shutters of the ordinary form where the armature of an electro-magnet forms a catch to retain the indicating disk, which, upon being released, falls into view.

These shutters are replaced by a push, which, it may be added, becomes, in the majority of cases, a continual source of annoyance and trouble. Somehow the push, with its easy spring, seems to invite hard treatment, with the consequence that the indicator is constantly out of gear, and hence earns the reputation of being untrustworthy. The fact is, the ordinary bluejacket, being unacquainted with the mechanism inside the indicator, imagines that it is his duty to hit the push a sudden blow in order to jerk the disk back into position, and a very little of this treatment suffices to wear out the catch; a simpler form of indicator would be a great advantage. It must also be remembered that a battleship it subjected to violent jerks from the discharge of heavy guns, as well as the vibration of the engines, all of which tend towards the wearing out of delicate parts.

The shutter coils are placed in water-tight boxes, and the circuit is arranged so as to have each shutter coil in series with the bell belonging to the particular group at its station.

In order to establish communication, the push in connection with the station to be called up is pressed, which allows the current to pass the corresponding shutter coil and bell of the distant station, dropping the disk and giving the alarm.

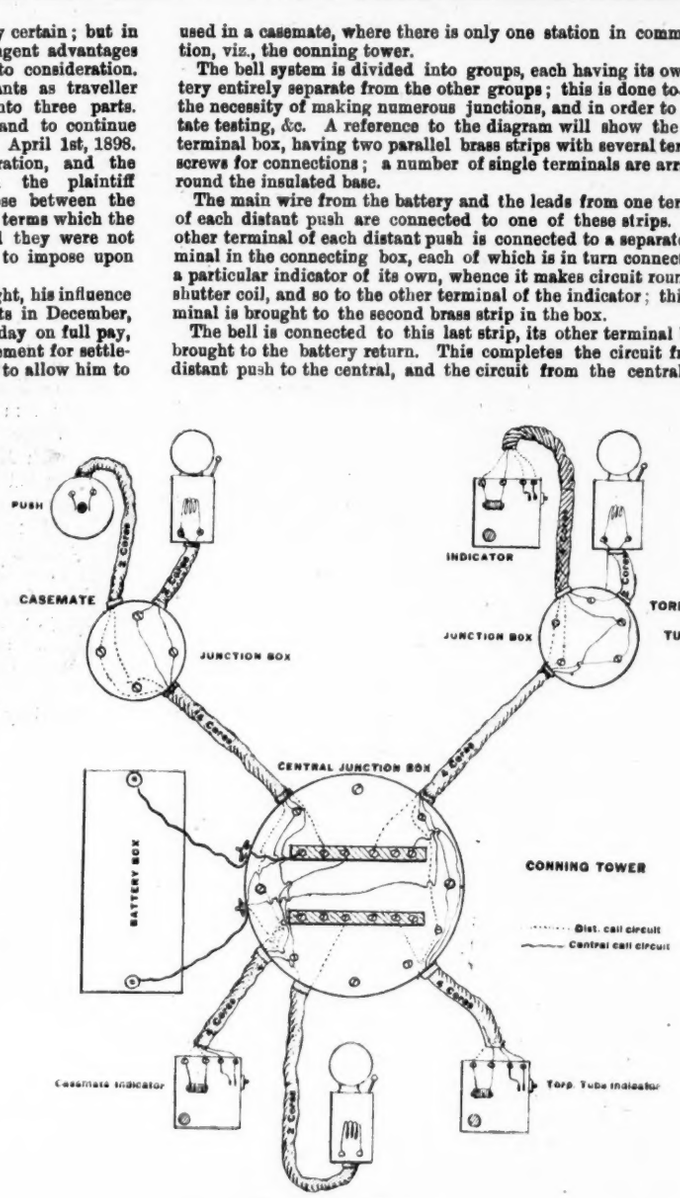
In a similar manner the reply is received, and, since each circuit s different, four wires are required between any two stations. A large number of wires are thus required at any central station, such as the conning tower or chart house, and the system appears, in consequence, a little complicated.

The diagram shows connections to two stations, one of which has an indicator fitted, and the other only a call bell, such as would be used in a casemate, where there is only one station in communication, viz., the conning tower.

The bell system is divided into groups, each having its own battery entirely separate from the other groups; this is done to avoid the necessity of making numerous junctions, and in order to facilitate testing, &c. A reference to the diagram will show the large terminal box, having two parallel brass strips with several terminal screws for connections; a number of single terminals are arranged round the insulated base.

The main wire from the battery and the leads from one terminal of each distant push are connected to one of these strips. The other terminal of each distant push is connected to a separate terminal in the connecting box, each of which is in turn connected to a particular indicator of its own, whence it makes circuit round the shutter coil, and so to the other terminal of the indicator; this terminal is brought to the second brass strip in the box.

The bell is connected to this last strip, its other terminal being brought to the battery return. This completes the circuit from a distant push to the central, and the circuit from the central to a



Naval Bell Circuits.

distant station is practically the same, and may be traced as follows:—From the battery to the battery strip, and on to the push, from which it goes to a terminal in the connecting box; from here it goes to the distant indicator, and so through the bell back to the return wire, which is joined to the battery return.

Later patterns are now in use where a third strip is used for the return battery wire. Lead cased four-core cable is used to connect the distant stations.

Terminal boxes have all their terminals numbered, and a label on the lid shows the use to which each is put.

BUSINESS NOTES.

Wood Fibre.—The City of London Wood-Wool Co., of Plover Works, Hackney Wick, N.E, send us a sample of their wood fibre, which, we understand, has met with great success as a cheap and efficient filtering medium for use in water-filtering plants. We gather that many electricity works and similar undertakings are employing this material in connection with their boiler-fed plants. The sample forwarded is clearly cut and free from dust.

Belgium.—The report of the Société de la Fabrique Belge des Crayons Electriques, of Liège, for the last financial year shows a loss of £540.

Trade Announcement.—The name of the firm, Derby and Co., platinum merchants, 44, Clerkenwell Road, E.C., has been altered to Derby & Co., Ltd.

Electrical Wares Exported.

Week ending September 15th, 1903.		Week ending September 13th, 1904.	
Amsterdam	Value £25	Adelaide	Value £125
Auckland	274	Alexandria	76
Bombay	85	Amsterdam	40
Calcutta	2,614	Antwerp. Elec. fuses	379
Cape Town	672	Bangkok	263
Cologne	17	Barbadoes	34
Colombo	458	Bombay	144
Constantinople	60	Brisbane	48
Delagoa Bay	44	Buenos Ayres	979
Durban	1,594	Calcutta	5
„ Teleg. mat.	851	„ Elec. machinery	844
East London	6	„ Teleg. mat.	140
Genoa	20	Canary Islands	14
Hong Kong	19	Cape Town	223
Lyttleton	93	„ Elec. machinery	511
Melbourne	300	„ Teleg. mat.	245
Nagasaki	263	Channel Islands	146
North Atlantic. 66½ miles submarine teleg. cable	—	Colombo	105
Ostend	56	Delagoa Bay	200
Perth	805	Durban	1,654
Port Darwin	60	„ Elec. machinery	1,480
Port Elizabeth. Teleg. mat.	1,739	„ Teleg. wire	1,109
Santander	59	East London	89
Spezia. Elec. primers	86	Fremantle	111
Sydney	71	Gibraltar	18
„ Teleph. cable	693	Hamburg. Elec. machinery	10
Toronto	14	Hobart	38
Wellington	257	Hong Kong	23
Westport	305	Larache	70
„ Teleg. wire	579	Lisbon. Teleg. mat.	461
Yokohama	85	Madras	50
„ Teleg. wire	718	„ Telephones	210
		Melbourne	110
		„ Teleg. mat.	43
		Mombasa	16
		Otago	63
		Paris. Elec. machinery	124
		Penang	212
		„ Teleg. mat.	435
		Pernambuco. Elec. machinery	162
		Perth	116
		„ Telephones	38
		Port Elizabeth	45
		Rangoon	14
		Rio Janeiro	260
		Rotterdam	17
		St. Petersburg	71
		„ Teleg. cable	810
		Santiago	37
		Santos	9
		Shanghai	527
		Sierra Leone	9
		Singapore	1,982
		„ Teleg. mat.	79
		Stockholm. Teleg. cable	77
		Sydney	700
		Valparaiso. Teleg. cable	149
		Wanganui	75
		Wellington	181
Total £12,872		Total £16,204	

Foreign Goods Transhipped.

Progresso. Telephones	Value £164	Hobart. Elec. goods	Value £57
		Rio Janeiro. Elec. fittings	205
		Total	£262

Imports of Foreign Electrical Machinery.—There was rather a heavy importation of foreign electrical machinery into this country, the returns showing a total of £56,745, as against £46,732 in July last, and £33,791 in August, 1903. So far as the year has gone, however, it has failed to reach the figures recorded in 1903, the imports during the eight months ending with August being valued at £372,921, as compared with £391,537 in the corresponding period of last year.

Brush Contracts.—The Brush Electrical Engineering Co., Ltd., have secured the following contracts:—

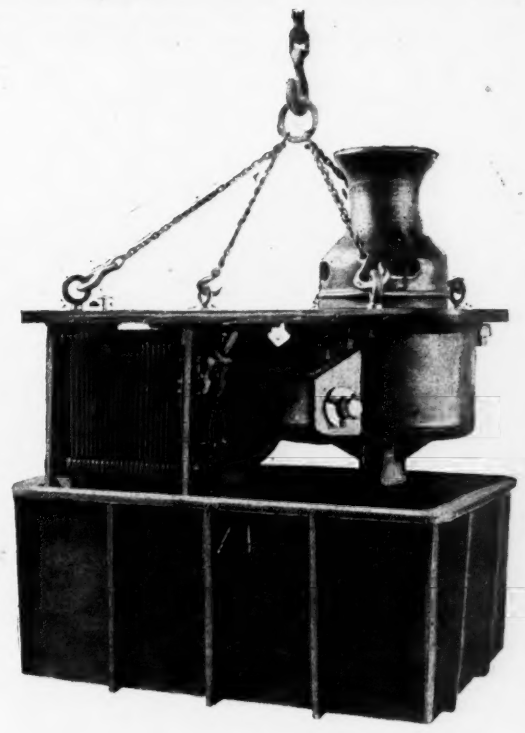
City of Birmingham Tramways Co.—Overhead equipment of Small Heath Tramways extension.

County of London Co.—Thirty-seven transformer switch pillars.

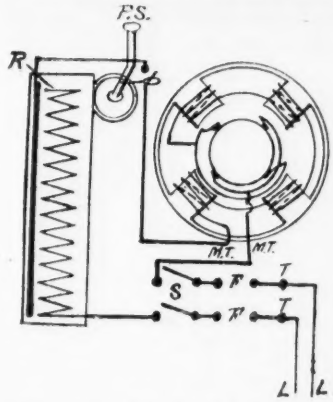
Electrical Capstans.—Messrs. Walker & Hodgetts, Ltd., Salford, are manufacturing a compact and accessible form of motor-driven capstan as shown in the accompanying illustrations. The motor, together with speed-reduction gear, and also the starting

Motor-driven Capstan.

switch and connections are mechanically fixed to a strong ribbed foundation plate. The whole of the parts can thus be raised from or lowered into the water-tight tank. The tank is provided with a machine flange in order to make a weather-proof joint between the tank and plate. The complete connections of the series-wound motor, starting switch, &c., are shown in the diagram. The capstan is operated by pressing and releasing the foot pedal to start and stop respectively, the switching gear being in all other respects automatic. Two circular inspection covers are provided in the top plate, these being placed in positions which enable the attendant to readily inspect the bearings and the commutator. The speed reduction gear consists of machine-cut worm and worm wheel, which are both entirely immersed in an oil bath. The lubrication of the shaft bearings is also automatic. The entire apparatus is made to



Capstan being lowered into Tank.



L, Line; T, Terminal; F, Fuse; S, Switch; R, Rheostat
F S, Pedal switch; M T, Motor terminals.

Diagram of Connections of Capstan, Motor and Switch, &c.

withstand rough usage and exposure to the weather in order to meet the requirements of railway and other goods yards where a simple form of haulage is essential.

The Boilermakers' Society.—The September reports of the Boilermakers' Society from the trade centres do not indicate any improvement anywhere. In some districts trade is described as being slack, and nowhere is it better than moderately good.

Cable-Making Activity. — We learn, on what would seem to be reliable authority, that the various British manufacturers of lead-covered cables for electric light, power, traction and telephone purposes, have recently been making unusually large purchases of lead. It is not unreasonable to suggest that this points to an approaching period of greater activity in this particular branch of electrical industry. Cable extensions mean, in the ordinary course of electric lighting, a need for more electrical energy, with new orders for steam and electrical generating plant—indeed, we suppose it is true that, in a degree, prosperity in one department has a beneficial effect upon other sections of the same industry. Dare we go so far as to hope that there is also at hand, therefore, a moderate, but general revival—not only of electric-cable making, but of all good-paying electrical business?

New "N.C.S." Ammeter.—Messrs. Nalder Bros. and Thompson, Ltd., of 34, Queen Street, Cheapside, E.C., have recently placed on the market a new cheap form of instrument that can be used as either ammeter or horse-power indicator. This has been very carefully designed, and possesses certain features of novelty. Fig. 1 illustrates the general appearance of the instrument. It is

constructed on the soft iron principle, special precautions having been taken to ensure its being quite suitable for direct or alternating currents, and to guard against any errors due to variation in frequency or in wave form. The instrument is completely screened

Fig. 1.

so as to render it unaffected by external fields. It is also fitted with a very efficient form of air damping, which, we are informed, makes the instrument absolutely dead-beat, and it can be used with satisfaction on any motor circuit, however fluctuating the load may be. Fig. 2 illustrates the working parts of this instrument, showing the damping arrangement. The great advantage of this square

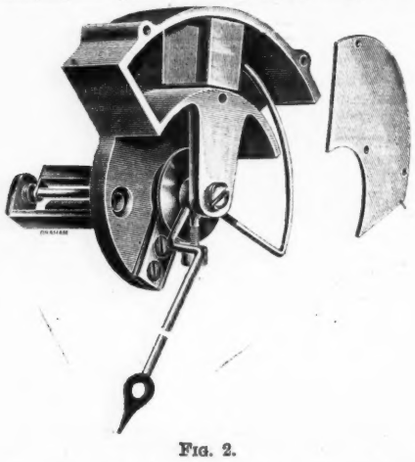
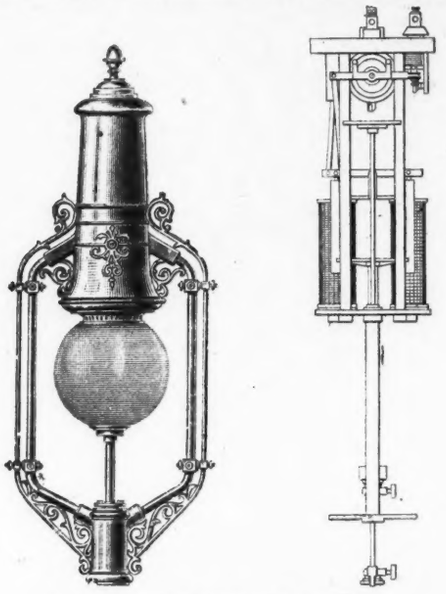


Fig. 2.

form of damping-chamber is that the top can at any time be removed, and the instrument be inspected, whereas in most of the existing methods of air damping, a cylindrical tube is used, made all in one piece, so that if anything goes wrong it is very difficult to put it right. The marking of the scale is bold, and can be well seen at a distance. The whole instrument is well adapted to fill the want of a reliable instrument at a moderate price, so that a separate one could be used with every motor on an installation.

J. & P. Arc Lamps.—One of the points which is frequently urged against the use of open type arc lamps for street lighting is the frequent trimming required. This objection, however, is met if a lamp is selected which will burn for 40 hours with one set of carbons. Messrs. Johnson & Phillips, of Old Charlton, have recently improved their double carbon open-type arc lamps so as to meet such conditions. In these lamps, when one pair of carbons has burnt out, the second pair lights up automatically. The carbons are held in carbon holders, which grip them truly. The sliding rods, with the negative carbon holders attached, and also those carrying the positive carbons, are each connected to pulleys on the brake-wheel spindle by a single piece of copper tape. The brakes are of simple and efficient design, and can be readily adjusted. The change over from one pair of carbons to the other is effected by the adjustment of the brakes, the second pair of carbons being held apart positively while the first pair are burning. Control of the arc is effected by an electro-magnetic system, which is the outcome of many years' experience.

When lamps are used in series a cut-out is necessary in order that all the lamps in a circuit may not be extinguished should the arc in any one lamp fail. The cut-out used in this lamp does not depend for its action on the motion of some other moving part of the lamp, and will, therefore, act if the arc should fail from any cause whatever. The globe is held in position by two catches which are provided with thumb places, and is supported, when lowered for trimming, by two steel rods. When in its usual position the globe is firmly held, and cannot be swung about even by a strong wind. In the top of the lamp is a bolt hole into which can be fitted one of several types of suspension insulator, suitable for the various



J. & P. Improved Open-type Arc Lamps.

kinds of carrier or bracket from which the lamp is to be hung. The insulation throughout the lamp is of mica and steatite where possible. A substitution resistance is generally used with the lamp, and this is brought into action by the automatic cut-out. These resistances can be supplied either for fixing over the lamp, or arranged to fit in a wall box, or in the base of the lamp-post.

Books Received.—"Journal of the Institution of Electrical Engineers." Vol. XXX., No. 168; August, 1904. London: E. & F. N. Spon, Ltd. 3s. 6d.

"Year Book of the Michigan College of Mines, 1903-1904," and "List of Graduates." Houghton, Michigan: Published by the College.

"Hawke's Maximum Telegraphic Code." Framed specially to conform to the Regulations of the Telegraphic Conference, (London), 1903. By Wm. H. Hawke. London: Whitehead, Morris & Co., Ltd. £1 1s.

New Editions.—We understand that Messrs. Charles Griffin & Co. will shortly bring out the sixth edition of Prof. Jamieson's Manual on Applied Mechanics, which is a companion book to the same author's Elementary Manual on Steam and the Steam Engine. They also hope to issue the fourteenth enlarged revised edition of Jamieson's text-book on Steam and Steam Engines, including steam turbines and boilers, and the seventeenth edition of Munro and Jamieson's Pocket-book of Electrical Rules and Tables, with the submarine cable and other sections up to date.

Railways in Rhodesia.—This is the title of a handsome publication which has been issued by the British South Africa Co., for the purpose of familiarising the public with the great attractions of Rhodesia. The railways and their construction are described in a very interesting way, and many excellent views of the lines and stations appear, but Mr. E. H. Smith Wright does not confine himself to railways, and to the general reader he is, doubtless, even more interesting in his notes on the country through which the railways pass. The description of the "Victoria Falls," by Mr. E. F. Knight, gives one something of an idea of their magnitude, and maps of the Niagara and Victoria Falls, which are placed on facing pages, when studied comparatively, impress one with the enormous industrial potentialities of the waters now running to waste on the Zambesi. When these falls have been "harnessed" by the electrical and hydraulic engineer for the purpose of electrical transmission to Rhodesian mines and townships, as is proposed under the scheme which has been under consideration for some time, and is, we believe, at this moment receiving attention, Rhodesian development will have made a momentous leap forward. One of the effects of perusing this beautifully got up brochure, with its numerous photographic reproductions, is to leave one charmed with the fascinating attractions of this front-rank British possession.

The Transvaal.—The value of the imports of electric cables, wire, and fittings, into the Transvaal during the five months ending with May last, is returned at £33,000, as compared with £27,000 in the corresponding five months of 1903.

Thos. Parker, Ltd., and Pattern-Makers' Wages.—It may be remembered that, at the July meeting of the Wolverhampton Town Council, the labour members alleged that, in a contract given to Thomas Parker, Ltd., electrical engineers, Wolverhampton, the "fair wages" clause was being infringed. The town

clerk was instructed to communicate with Messrs. Parker on the matter, and at the meeting of the Town Council on Monday last he read a long letter from the firm, vindicating their position and action. The letter stated:—

Dear Sir,—In reply to your letter of the 9th inst., we beg to state that we carry out the whole of the requirements of the clause in the general conditions under the headings "Rate of Wages and Sub-Letting." As regards your second question, the contract we are carrying out is for the supply of engines and dynamos, and does not include the supply of any patterns.

The specification relates entirely to the machinery supplied, and the manufacture and general design of the same is left in our hands. In order to carry out a contract of this description, it is necessary to have patterns and other tools, which are, and remain, the property of the contractor, and are not in any way included in the contract. The question of what tools are used is a matter entirely at the discretion of the contractors.

As a matter of principle, we decline to give the names of firms from whom we obtain such appliances. Further to the above, we wish to state that we do not consider it just that your Council should allow themselves to be brought into a question which is absolutely independent of the contract. This question dates from last summer, when the Pattern-Makers' Society applied for an increase in the district rate. In accordance with the recognised agreement between the Employers' Federation and the various trade societies, we had absolutely no power to either grant or refuse, but referred the matter to the Federation. After negotiations, we were informed that the increase was not granted, and consequently we continued to pay the same rate of wages, viz., 34s. a week, as we had previously.

In August last, without notice, the whole of our pattern-makers, whom we believed, although we had never questioned them, were members of the society, left of their own accord.

It is needless to say that the action of the men caused us a considerable amount of inconvenience, owing to our being unable to arrange at a moment's notice for the work to be done elsewhere. We were, however, in this position—that being members of the Federation we were obliged either to resign our membership or face the situation, and we chose the latter course. We tided over the difficulty, and some time afterwards gradually took on men in our pattern shop under the old conditions, but never intend to go through a similar experience, and shall always in future buy some of the work away, so that this work will be entirely lost to the Wolverhampton district.

We shall be much obliged if you will have this letter read in full at your next Council meeting, as the discussion which took place last week has been made public and was of such a character as would be calculated to do harm to us unless our side of the question is given equal prominence.—Yours faithfully, Thomas Parker, Ltd.

The letter was, without discussion, referred to the Electric Lighting Committee for consideration.

Telephonic Fire Alarms.—Mr. R. S. Blackburn, electrical engineer, of Hebden Bridge, sends us three views of his recently improved telephonic fire alarm boxes, which are of compact design and follow the normal practice, having a small window, which, on being broken, allows of the door being opened and access obtained to the telephone.

The Engineering Trade.—The monthly report of the Amalgamated Society of Engineers, published on Saturday, says that during the past month a conference was held with the employers' federation executive, when matters were dealt with from Birkenhead, Chatham, Leeds, Lincoln and Bristol. With regard to the resuscitation of the claim of the north-east coast employers for a reduction of wages, the executive of the society had instructed their local official to decline to accept the notice, and to request its withdrawal pending the discussion of the men's recent claim for an advance. The membership was now 96,098, of which 5,235 were on the unemployed benefit list, 2,049 on sick pay, and 4,738 on superannuation.—*The Times.*

Educational Notices.—As the several announcements which have lately been appearing among our advertisements will have indicated, the various technical colleges and institutions will shortly settle down seriously to the classes and lectures of the 1904-5 session. Many of them have issued their syllabus of arrangements, and intending students in electrical and allied subjects should make application for these at once.

We have this week received from the South-Western Polytechnic, Manresa Road, Chelsea, a set of their prospectuses relating to the day and evening classes, and these are offered at a nominal fee of one penny (post paid, 3½d.).

During the coming session, which commences on October 3rd, elementary, advanced and honours courses in electricity and magnetism will be given at the Borough Polytechnic Institute, and a further course of twenty lectures for electrical engineers and others engaged in electrical work will be held in electrical and magnetic measurements. Both lectures and laboratory work will be under the direction of J. Henderson, D.Sc.

On Monday next, September 19th, Mr. W. R. Cooper, M.A., B.Sc., will commence a series of lectures to the senior students at the Electrical Standardising, Testing and Training Institution on the subject of "Secondary Cells."

Catalogues and Lists.—The Lahmeyer Electrical Co., Ltd, has issue a couple of preliminary price-lists, one for continuous current motors up to 10 H.P., and the other for the Schuler patent single-phase alternating current motors. Speeds, outputs, weights, and prices are given. A new list is now in course of preparation, detailing the advantages of the Schuler motor.

The C. W. Hunt Co., of America, is circulating a new illustrated catalogue of electric hoists, winches, and capstans for working by direct or alternating currents.

A pamphlet has been issued by the Westminster Electrical Testing Laboratory, giving a scale of fees for carrying out tests of electrical lamps, machinery and apparatus, also tramway materials, coal, &c.

Messrs. Johnson & Phillips, electrical engineers, of Old Charlton, Kent, have forwarded us their price list B (August, 1904), of direct current motors.

The Allis-Chalmers Co., of Chicago, have sent us an artistically got-up publication, entitled "The Book of the Four Powers;" it treats of the firm's well-known achievements in connection with steam, water, gas, and electrical power plants. We note among the illustrations some capital pictures of the engine plants installed at Ringsend power station (Dublin), the L.U. Tramways Co.'s generating station, the Central London Railway power house, also at Sydney and Havana. As the Allis-Chalmers Co. recently acquired the Bullock Electric Manufacturing Co., of Cincinnati, the Bullock generators and motors are particularised.

Messrs. Ernest F. Moy, Ltd., in a newly-issued list, detail their No. 104 type switch fuses for pressures up to 500 volts.

A circular relating to "Excitine," a new excitant for primary batteries, has been received from the Premier Electrolyte Co., of 26, Spital Square, Bishopsgate Street, E.C.

We have received a well got up small standard size catalogue of the Rust boiler. This is an American boiler of the vertical water-tube type, with external furnace of brickwork. There are two upper drums and two main lower drums, with an auxiliary central drum to carry the tubes, which hold a central brick baffle wall. The lower drums have water connection, and the two upper drums are connected through the top header of the baffle wall tubes. The boiler appears to be compact. All the tubes are straight, and can be seen through. This straightness of tubes seems to be a highly valued feature of late, which may perhaps have been overpraised. Even nominally straight tubes have sometimes to be curved slightly for expansion exigencies.

Liquidations.—The Crypto Works Co. Ltd., resolved on August 19th to wind-up voluntarily, as it could not by reason of its liabilities continue the business. Mr. Elles Hill, 79, Mark Lane, E.C., was appointed liquidator.

The "Never-Wet Seat" Co., Ltd., of Manchester, is winding-up voluntarily, with Mr. Geo. Roberts, 40, Bury New Road, Bolton, as liquidator.

Bankruptcy Proceedings.—An adjudication order was made on September 5th, in *re* Henry Bock Binko, electrical engineer, of 34, Leadenhall Street, E.C., and Highbury.

Errata.—In our Lists of Electricity Works, under the head of Charing Cross and Strand, storage battery, for "Fluger" read Pfluger (for Pfluger Accumulator Works). In the Tramway Sheet, under Great Grimsby and Cleethorpes, the electrical engineer is Mr. S. E. Barnes.

LIGHTING AND POWER NOTES.

Aberdeen.—The T.C. has reduced the price of energy per unit for private lighting from 6d. and 2½d. to 6d. and 2d., and for public lighting a reduction of ½d. per unit after the first hour also.

Ayr.—The annual report of the burgh engineer shows that the total number of consumers amounted to 776, as compared with 681 last year. The number of units generated amounted to 1,014,774, of which 335,842 was consumed by the tramways, the increase over last year being 102,593 units. The capital expenditure was £87,525, an increase of £4,015. The total income was £11,258, an increase of £647. After meeting expenses, there remained a credit balance of £628, as compared with £301 last year.

Beaumaris.—The T.C. has resolved to apply to the B. of T. for a prov. order enabling it to supply energy for electric lighting and power in its district.

Belfast.—The Works Committee of the Harbour Board has recommended that two electric cranes, for handling coal at Queen's Quay, be obtained from Messrs. J. H. Wilson & Co.

Birkenhead.—The T.C. has received the sanction of the B. of T. to its borrowing £20,000 for extensions of lighting mains and service wires in connection with the electric lighting undertaking. The B. of T. intimated that before sanctioning the raising of any more money, it would require to know how the sum now authorised had been expended, and to be supplied with a map showing the position of the mains.

Bishop Auckland.—It is stated that the scheme for supplying electric light and power to the town has been transferred from the County of Durham Electric Power Distribution Co. to the Cleveland and Durham County Electric Supply Co., whose works are being erected at Fylands Bridge, near to Bishop Auckland.

Cardiff.—With the South Wales Electrical Power Distribution Co. "nibbling" on the boundary of the borough, the Corporation Lighting Committee has decided to offer as cutting a price as possible for the supply of energy for power to the Ely Paper Mills, who require two million units per annum for motive power purposes.

Tenders have been received for the erection of a sub-station at the docks. The sum sanctioned by the L.G.B. being only £15,000, and the tender being for a larger sum, it was decided to communicate again with the L.G.B.

Cheriton (Kent).—The U.D.C. has been informed by the B. of T. that it has revoked the Cheriton U.D. E.L. Order, 1899.

Clydebank.—The T.C. lately received an inquiry as to whether it would now take a supply of electricity for public lighting purposes, it being explained that, as the alternating current system would be more suitable for the burgh and district, the company were prepared to bear the expense of altering the wiring in the Municipal Buildings from the D.C. system to the A.C. The T.C. Committee agreed to adhere to the D.C. system, as stipulated in the agreement with the Clyde Valley Co., but to allow a rotary transformer to be placed within the buildings alongside the present dynamos, provided the company would take over the dynamos at a valuation.

The company afterwards suggested the introduction of concentric wires, which could be drawn through the present tubes without breaking out any of the plaster or woodwork of the building; and on expert advice, the Committee has decided to allow the alteration of the wiring of the buildings on certain conditions.

Croydon.—The Corporation has adopted the following charges for power purposes:—For consumers who require power at all hours, 2½d. per unit; or, on the time switch system, from 11 p.m. to dusk next day, at 1½d. per unit; and during the hours from dusk until 11 p.m., if consumers required to run their motors, 5d. per unit. Supply will not be cut off on Wednesdays and Sundays. The total number of motors connected up at present amounts to 28, equivalent to 130 H.P.

Dublin.—In connection with the E.L. scheme, a somewhat novel development has taken place. Apparently owing to the unsatisfactory condition of the Pigeon House plant, and the urgency of providing for the coming winter load, rumour has it that the Tramways Co. contemplated making an offer to the Corporation, taking over certain of the latter's plant and guaranteeing to supplement it as required for the coming winter. Mr. Hammond has, however, anticipated the Tramway Co. by making two alternative offers in connection with the Pigeon House system. For the last twelve months he has been in absolute charge of the entire municipal system of electric lighting. On August 25th he addressed a letter to the Lighting Committee, in which he reviewed the working of the Pigeon House scheme during the last twelve months, and made two alternative offers to the Corporation. The first is to become the managing superintendent engineer without a salary, and to receive as remuneration a certain amount per unit of electricity produced at the Pigeon House. The amount in question is the excess of 1½d. (the proposed selling price to the Corporation) over the actual cost of production per unit. Mr. Hammond's alternative offer is to take over the whole scheme of municipal electric lighting, and run it for 14 years, charging the citizens the same prices as those which the Lighting Committee has scheduled, and paying in the interval the charges for interest and sinking fund in connection with the existing loans of close on half a million pounds. Meanwhile the Chairman of the E.L. Committee has circularised his fellow Committeemen with reference to Mr. Hammond's proposals, and points out that they can hardly be taken seriously; he concludes by suggesting that the Committee should recommend the Council to inform Mr. Hammond that it sees no reason for departing from the decision to work the E.L. department itself.

Dulverton.—A local works owner some time ago put down a plant to supply electric light to his shops. A number of tradesmen and residents having expressed a wish to have the same illuminant, the Dulverton Electric Light Co. was formed, and new works erected. The new building consists of an engine and dynamo room, gas generating room, battery room, stores, and offices. A Crossley gas engine of 30 H.P. has been installed, and the battery comprises 60 cells with an output of 130 amperes. Thirty Nernst lamps, of 150 C.P. each, are being erected for street lighting. Energy is supplied by means of overhead conductors. There is a considerable demand for energy, and it is anticipated that the plant capacity will have to be increased. The general manager of the company is Mr. Berners, of High Street, Exeter.

Lytham.—St. Anne's U.D.C. has informed the Lytham Council that it is prepared to discuss terms for the supply of energy in bulk to Lytham.

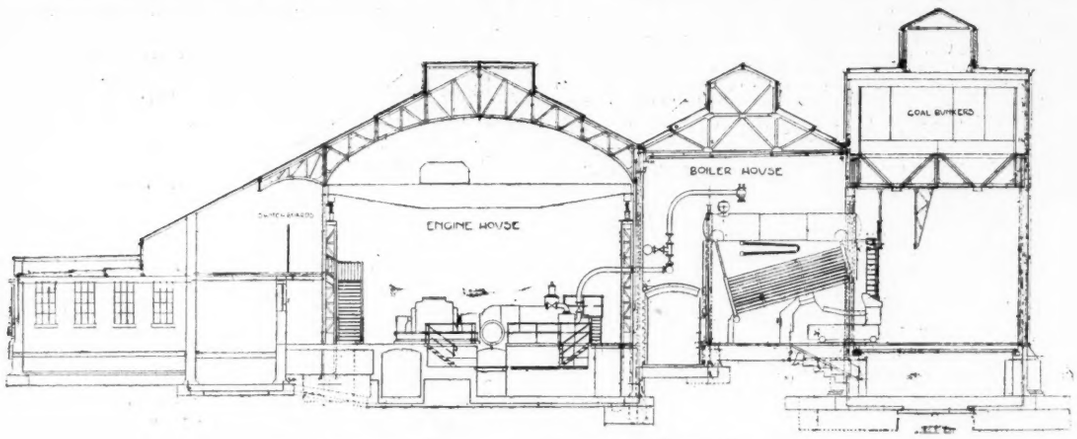
Germany.—An electric power station, utilising certain available water power, is about to be established in the Quiestalsperre, Marklissa. The plant to be first put down, will consist of three water turbo-generators, tenders for the supply of which are shortly to be invited.

(*Continued on page* 463.)

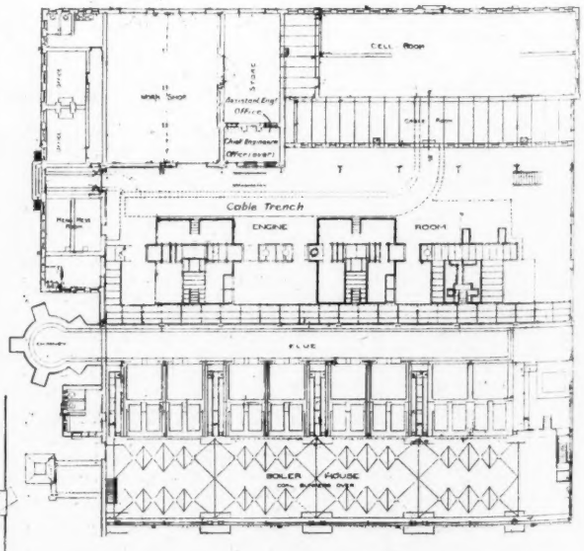
NORTH METROPOLITAN ELECTRIC POWER SUPPLY AND TRAMWAYS.

(*Continued from page* 423.)

Up to the present, the company has erected four sub-stations for the supply of power to the Metropolitan Electric Tramways, namely, at Edmonton, Wood Green, Finchley and Hendon. The first three of these are fed from Brimsdown generating station (and the Hendon sub-station from the Willesden station), by means of underground cables, supplied by the British Insulated and Helsby Cables, Ltd., of Prescot and Helsby. The cables, which are laid in duplicate, are of the three-core type, each core being of 0·1 square inch cross-section; they are paper insulated and lead covered, and are laid in troughs filled up with bitumen. The longest of these cables will extend to no less than 18 miles in length, feeding Hendon sub-station. The whole of the equipment of the sub-stations, except the travelling cranes, was supplied by the British Thomson-Houston Co., Ltd., of Rugby.



Cross-sectional Elevation of Brimsdown Power Station.



Plan of Brimsdown Power Station. (For description see pp. 419—423.)

The sub-stations are generally similar in their arrangement and equipment, and we may take the one at Wood Green as typical of them all, except Edmonton, which is smaller. The Finchley sub-station is not yet completed.

At Wood Green the plant is housed in a neat brick building, well lighted from the roof; the walls are lined with a green dado, and white enamelled bricks up to the level of the crane rails. One end of the building is temporarily closed with galvanised iron. Incandescent electric lamps provide for lighting at night, with gas as a stand-by; the former are fed directly from the terminals of the machines. Over each switchboard there is an iron framework to prevent the chains of the travelling crane from sweeping the face of the switchboards. The crane, which is operated by hand from the floor, was supplied by Messrs. Morris & Bastert, of Loughborough, and is of 7½ tons capacity.

Wood Green Sub-station: Extra-High-Pressure Switch Gear.

The converting plant comprises three rotary converters, supplied, with the rest of the electrical equipment, by the British Thomson-Houston Co., Ltd., of Rugby. The rotaries are of the three-phase type, compound-wound, with eight poles, and run at 750 r.p.m.; they have each an output of 455 amperes D.C., and are fed with alternating current at 340 volts, 50 cycles per second. Damping devices are fixed between the pole-pieces. Each machine is provided with an induction motor for starting and running it up to synchronous speed, the rotor being mounted on the end of the main shaft.

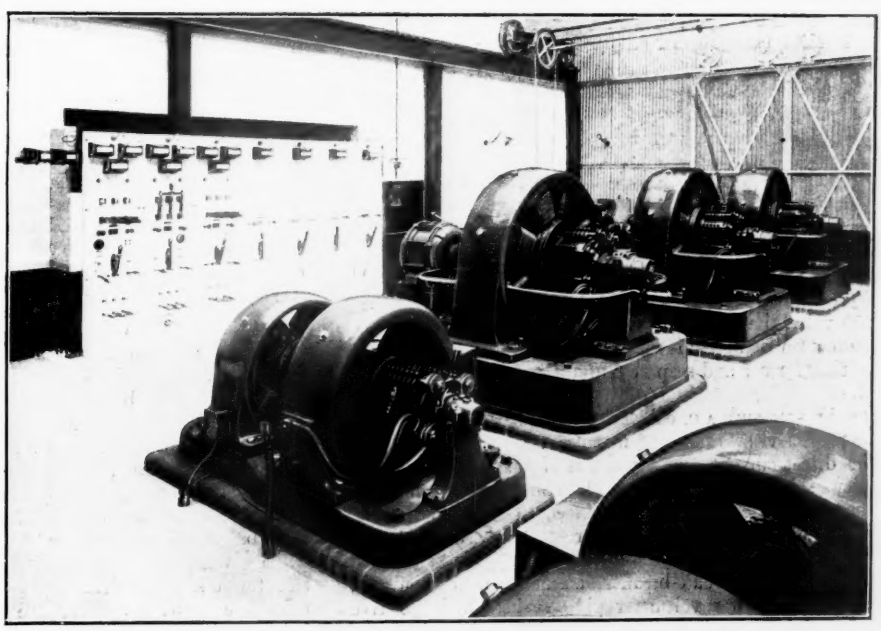
Equalising and negative main switches are fixed on the field magnet frames, the former being of the throw-over type, so that the series winding can be short-circuited if necessary, and the machines run shunt wound. End-play springs are fitted on the bearings.

Besides the converters, there are installed three negative boosters with four-pole fields, each rated at 400 amperes, 50 volts; the generator fields are excited by the current flowing to the corresponding feeders, and regulated by diverting rheostats on the D.C. switchboard.

Four extra-high-pressure feeders end at this sub-station, two incoming from the generating station at Brimsdown, and two outgoing to the sub-station at Finchley. These are controlled, together with the transformers, by the switchgear on the main A.C. switchboard, shown in the adjoining illustrations. This board consists of seven panels of white marble, of which four are devoted to the feeders above-mentioned; these feeder panels carry each an ammeter, and the operating handle of a high-pressure main switch.

Red and green lamps on the front of each panel light up when the corresponding switches are alive: the green lamp shows that the switch is closed, the red one that it is open, but alive. When both lamps are out, the switch is open and dead. The other three panels are allotted to the rotary converters, A.C. side, and the transformers associated therewith; each is equipped with a Thomson voltmeter, ammeter and power factor indicator, three-pole switch to connect the rotary converter with the secondaries of the transformers, synchronising and voltmeter plug sockets, main extra-high-pressure switch operating handle, two single-pole switches for loading the converters when synchronising, and a three-pole starting-switch for the induction motor. The middle panel of the three carries also a stepped rheostat, which can be connected with the A.C. side of any of the converters by means of the loading switches above referred to, and is used for artificially loading the converter when about to parallel, so as to bring it into synchronism with the bus-bar frequency. At the end of the board, bus-bar and synchronising voltmeters are mounted on a swing bracket.

There is no high-pressure apparatus whatever on the A.C. board, the extra-high-pressure switches being located in a switchroom at the back of the board, and operated by long iron rods connected with the handles on the switchboard.



Wood Green Sub-station: View of Interior, showing A.C. Switchboard.

We give a view of the interior of the switchroom, which is accessible only through a locked iron door. The switches differ from those at the generating station, being smaller

and only capable of being operated by hand; the rods will be seen close to the floor. The feeders come in at the back of the room, and after passing through dividing boxes, are carried overhead on insulators to the switchgear, and thence to the high pressure bus-bars, which are protected by inverted slate troughs, as shown. The transformer primary cables are similarly carried overhead, and pass through the switches to the same bus-bars. There are seven three-pole oil-break switches, each pole being enclosed in a separate brick compartment, closed by an iron door; two compartments contain pressure-reducing transformers for the instruments. The current-transformers are mounted on the main cables themselves. The high-pressure cables are protected by overload tripping gear, fitted to each feeder switch, while the instruments are protected by fuses on the secondary sides of their respective transformers.

The transformers are situated behind the switch room, and are of 92 KW. capacity each, single-phase delta connected. An induction regulator is provided with each set of three transformers. The transformers are oil-cooled and are fitted with terminals, by means of which the primary voltage can be varied from 10,000 to 9,000 volts, in steps of 250 volts, the secondary voltage remaining at 340 volts. The induction regulator is rated at 18 volts, 465 amperes. A spare transformer and a spare induction regulator are provided.

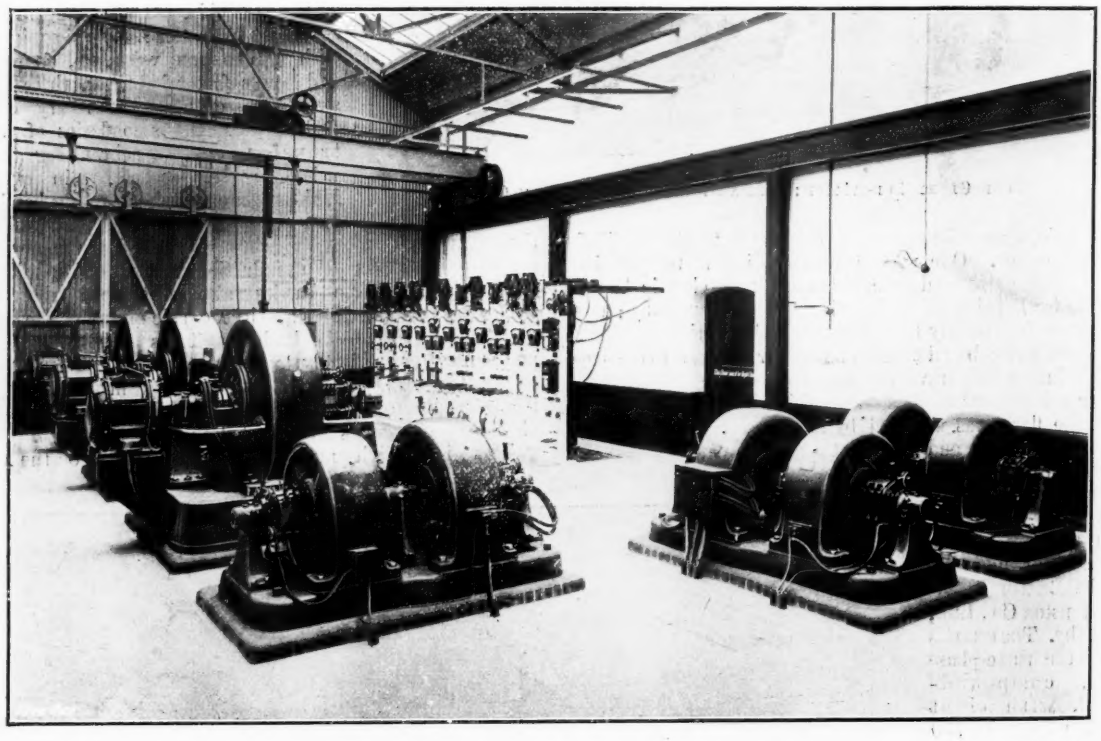
The low-pressure A.C. cables are carried beneath the floor to the respective switches and machines.

The direct-current switchboard is also shown in one of our views; it consists of 12 marble panels, of which three are generator panels, six alternately feeder and booster panels, two feeder and distributor panels respectively, and a Board of Trade panel. Each of the generator panels is fitted with a reverse-current circuit-breaker, ammeter, field regulator, machine and bus-bar voltmeter plug sockets, main positive switch, and stepped resistance switch for starting from the D.C. side. A station lighting switch is also provided. Three feeder panels are equipped with circuit-breaker, ammeter, main switch, and motor-starting rheostat; the booster panels with circuit-breaker (for the motor), ammeters, booster voltmeter, and field-diverting rheostat, and three switches for controlling the booster main and field circuits, the positive feeder current passing through the booster field windings. The remaining feeder panel and the distributor panel are equipped each with a circuit-breaker, ammeter, and main switch.

There is a bracket generator voltmeter at the end of the board. Watt-hour meters are installed to record the total input and output of the sub-station.

Private telephone circuits to Edmonton, Finchley, and Brimsdown are provided, and also to all the section pillar boxes.

The Edmonton sub-station is situated near the present terminus of the tramways, and is the smallest; we give a view showing the interior of the converter room. There are two rotary converters, each of 100 KW., and running at 1,000 r.p.m. Space is available for a third machine. Each converter is provided with an induction motor for starting up, the rotor being fixed on an extension of the main shaft. The walls are provided with a dado, and are faced with white enamelled bricks up to the crane rails; the floor is laid with mosaic, and the roof is of the lantern type. A small Morris & Bastert hand crane is provided. The main switchboard, which is fixed parallel with the machines, consists of eight marble panels. Six of these are feeder panels, providing for four incoming and two outgoing feeders; they are fitted with ammeters and main switch operating handles.

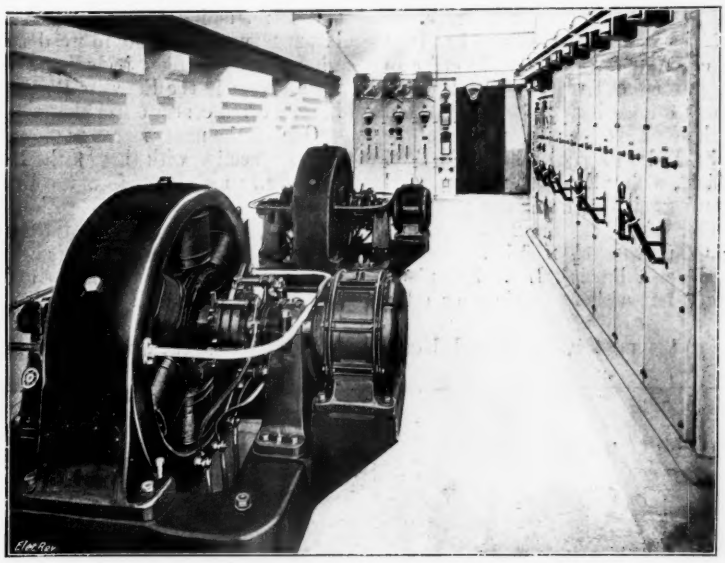


Wood Green Sub-station: General View of Interior, showing D.C. Switchboard.

The two rotary converter panels are equipped with ammeter, voltmeter, and power factor indicator, main A.C. switch, bus-bar loading switch, induction motor switch, and field regulator. The bus-bar loading switch is used in synchronising, to load the A.C. side of the rotary and thus adjust the speed. The extra-high pressure switches are like those at Wood Green, and are operated by iron rods from the handles in front of the switchboard. All the extra-high-pressure apparatus is enclosed in a switch room behind the board, accessible only through an iron door, which is kept locked. Behind the switch room are the transformers, of the single-phase type, connected in delta; these are of 37 KW. each, and are seven in number, one being spare. There is an induction regulator in connection with each set of three transformers.

The direct current board consists of two generator panels, each fitted with a reverse current circuit-breaker, ammeter, field regulator, throw-over lighting switch, main switch, and stepped starting switch (for use in starting up from the direct current bus-bars). There is one feeder panel, fitted with circuit-breaker, ammeter, and switch, and the remaining panel is allotted to the Board of Trade instruments.

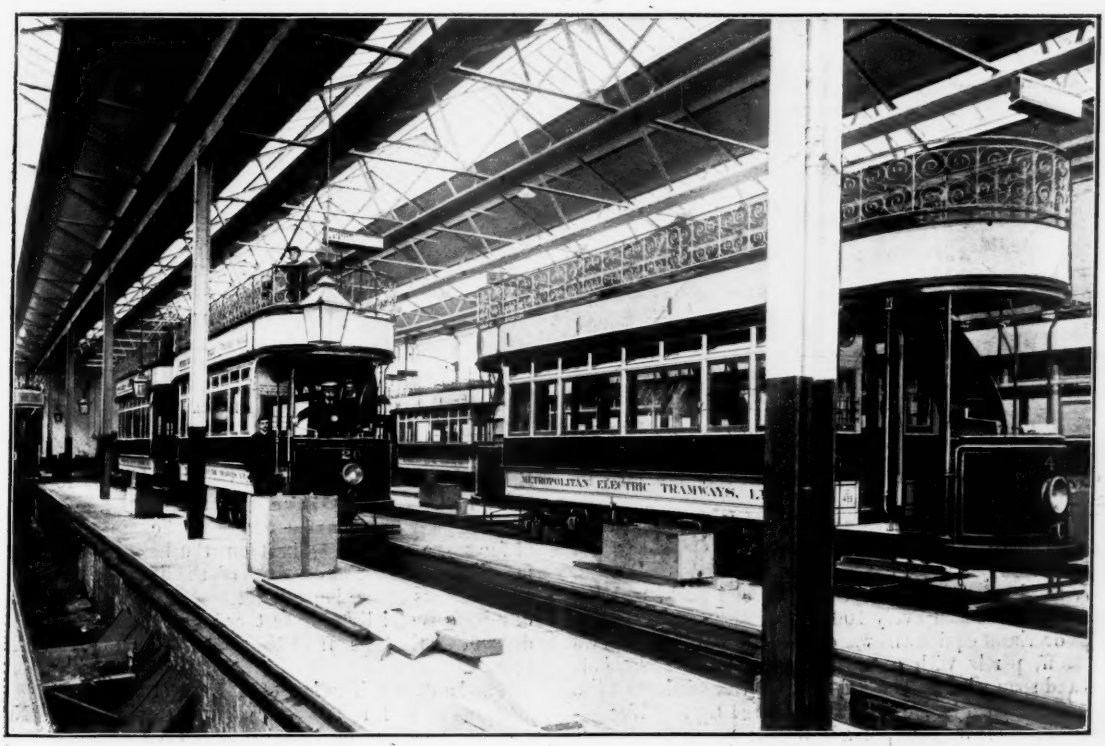
Both at Edmonton and Wood Green there are large car-sheds, belonging to the Metropolitan Electric Tramways, Ltd. The former is capable of accommodating 36 cars at present; the latter, of which we give a view, has a capacity of 62 cars, and is immediately to be enlarged. Car-sheds are also being erected at Finchley and Hendon, and the last-named, which is now completed, stands on a site of 8½ acres which has been purchased to eventually become the head-quarters of the whole repairing system. The existing car-sheds at Edmonton and Wood Green were taken over from the North Metropolitan Tramways Co.; they were enlarged, and the roofs were raised to suit the electric cars, which require more head room than the old horse cars.



Edmonton Sub-station.

The cars were supplied by the Brush Electrical Engineering Co., Ltd., of Loughborough, the first order embracing 150 cars of the double-deck pattern, seating from 68 to 74 passengers each. They are all mounted on Brush maximum traction trucks, and equipped with B.T.-H. motors, type G.E. 58, and B. 18 controllers, as well as with B.T.-H. trolleys and trolley heads. Hand and rheostatic brakes, and life-guards of the Tidswell and the Wilson & Bennett types, are provided. The destination signs are of the illuminated roller-blind pattern. Recognising the serious drawbacks of the reversed stairway, the company has adopted the ordinary type for some of its cars, and the London United Tramways Co.'s pattern for others. The cars are decidedly handsome in appearance, and are well finished in all respects.

In the reconstruction of the tramways for electric traction, and the erection of the electrical equipment and the cable laying, the engineer-in-chief to the Metropolitan Electric Tramways, Ltd., Mr. A. H. Pott, was fortunate in having as his assistant Mr. S. G. Smith, who superintended the whole of this part of the work. In our issue of July 29th last, we gave a map showing the whole system of tramways, existing and projected, in connection with, or forming part of, the company's undertaking. Up to the present the lines completely reconstructed and equipped for electric traction include the routes from Finsbury Park to Wood Green and Tottenham, and from Wood Green to Tottenham, *viâ* Lordship Lane (the latter being the first completed section of the Middlesex County Council's tramways).



Interior of Car-shed at Wood Green.

Work is in progress on the Great North Road, from Highgate Archway to North Finchley, and on the Edgware Road, from Cricklewood to Edgware. The total length of track contemplated in the complete scheme amounts to 47 miles,

of which 8½ miles were purchased from the North Metropolitan Tramways Co., and reconstructed by the Metropolitan Electric Tramways, Ltd., and the remainder has been constructed, or is in course of construction, by the County Councils of Middlesex and Hertfordshire, as light electric railways. The whole of the tramways are double track.

The reconstruction of the old horse tramway has been carried out by Messrs. Dick, Kerr & Co., Ltd. In order to obtain sufficient head-room for the large electric cars, the roadway under three railway bridges had to be lowered, and in some cases the thoroughfares have been widened. All the special track work was supplied by Messrs. Hadfield's Steel Foundry Co., Ltd., Sheffield, with "Era" manganese steel points 12 ft. long. The rails weigh 101 lbs. per yard, and are in 45-ft. lengths. The fish plates are 2 ft. long, and weigh 47 lbs. per pair; the tie bars, $1\frac{1}{2} \times \frac{3}{8}$ in., were supplied by Messrs. Bayliss, Jones & Bayliss, Ltd. Sole plates $24 \times 8 \times \frac{5}{8}$ in. are used, but without anchors or other special jointing devices.

The paving consists, for the most part, of wood blocks set on a 6-in. bed of concrete, but granite setts are used in places.

The bonds are of the Neptune type, of No. 0000 B. & S. gauge, supplied by Messrs. W. F. Dennis & Co.; two are fitted at each joint. Plastic bonds, supplied by Messrs. R. W. Blackwell & Co., are used for special work, and the rails are cross bonded every 100 yards.

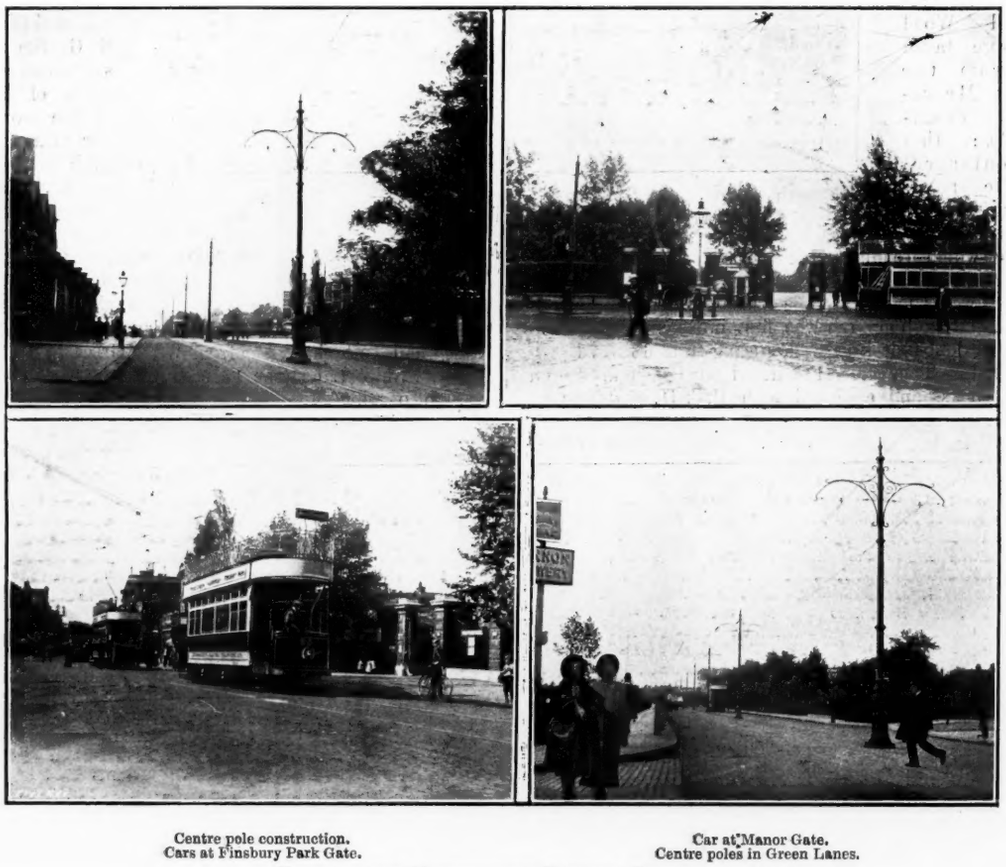
The overhead equipment was carried out by the company's own staff, partly with centre poles, and partly with side poles and span wires. The poles are of the sectional type, and were supplied by Messrs. John Spencer, Ltd., of Wednesbury. The pole bases were made by Messrs. John Forster and Co., Ltd., of St. Helens, and W. Lucy & Co., of Oxford. Flexible bowstring suspension is adopted where centre poles are used, these being of graceful design, as shown in our illustrations.

The trolley wire is of hard-drawn copper, ·409 in. in diameter, and was supplied by Messrs. Fred. Smith & Co., Ltd., of Salford. The ears were supplied by Messrs. Estler Bros., and the frogs by Messrs. Thomas Noakes & Sons, London. The section boxes, which are fitted with switch-fuses, choking coils and lightning arresters, test wire and telephone terminals, were supplied by the British Thomson-Houston Co., Ltd., and Messrs. Blackwell & Co., Ltd.

The feeders were supplied and laid by Callender's Cable and Construction Co., Ltd., and are of their vulcanised bitumen type, laid solid in wood troughing throughout the whole of the system, including the County Council's tramways, except in the Edgware Road, where the cables are laid in steel cored concrete troughs.

One of the most important features of the system is its close connection with that of the North Metropolitan Tramways Co., which leases from the London County Council its Northern horse tramways within the county boundaries. Junctions are effected between the two systems at several points, the combination thus affording an invaluable means of facilitating transit between the city and the northern suburbs, comparable only with the system of the London United Tramways in the west, but superior to the latter in its closer connection with the business centres. The Great Northern Railway and the Great Northern and City Electric Railway also serve as feeders to the electric tramways, and *vice versâ*. The company has adopted a liberal policy in the reduction of fares, the rates being fixed on the basis of "workman's fares" throughout, at all times of the day. We trust that this generous concession will not lead to demands on the part of rapacious socialists for further reductions to workmen, to distinguish the latter from the general public by pauperising them.

The happy combination of a large electric traction load with the general lighting and power service of the North Metropolitan Electric Power Supply Co. augurs well for the prosperity of the latter also, enabling the company to start operations with a good load factor and an assured demand. The eastern portion of the tramway system will be supplied entirely from Brimsdown, while the remaining districts will be supplied from the company's power station at Willesden, and, if necessary, from Hertford electricity works, both of which we shall deal with later. Several local authorities have already entered into agreements to take electrical



Centre pole construction.
Cars at Finsbury Park Gate.

Car at Manor Gate.
Centre poles in Green Lanes.

Views on the Metropolitan Electric Tramways.

energy for lighting and power from the supply company; and, having regard to the whole of the circumstances, we feel amply justified in forecasting a prosperous and beneficial career to the three companies concerned. We may add that these concerns are so closely allied financially and otherwise, that their harmonious co-operation is ensured, and the technical and commercial abilities of their directorates and staffs are such as to admit of no misgivings on the score of management.

(*To be concluded.*)

LIGHTING AND POWER NOTES.

(*Continued from page* 458.)

Bristol.—The L.G.B. is to hold an inquiry to-day into the application of the Corporation to borrow the sum of £126,000. This amount is required for extensions and equipment of the Avonbank works, and for further plant at Temple Back, as recommended by the Committee and passed by the Council in May last.

Burslem.—The B. of G. has received from the L.G.B. sanction to raise a loan of £15,700 for the provision of E.L. plant, and the carrying out of certain alterations.

Bury.—The T.C. has offered to give a supply of electricity to the new workhouse hospital at 3½d. per unit, flat rate, with a minimum annual payment of £200, for a period of 10 years.

Holyhead.—At a special meeting of the Council it was arranged that the opening ceremony of the electric lighting works should take place on the 16th inst. It also was decided that £16,000 be at once borrowed for the purpose of the electric light works.

Kearsley.—The U.D.C. has opened negotiations with Messrs. Foote & Milne for establishing a supply of electricity within the township, Mr. G. Vaughan Fowler is also applying for a prov. order.

Lancashire Electric Power Co.—The generating station for this company at Radcliffe is approaching completion, and negotiations for the supply of energy in bulk are far advanced with Rawtenstall, Bacup, Haslingden, Swinton and Pendlebury, and various other local authorities. The supply of energy in bulk to collieries promises to be a feature in the working of this undertaking.

London.—Marylebone.—The L.C.C. has sanctioned the borrowing for 42 years by the B.C. of £340,405 for electric lighting works, subject to the latter body's providing out of a sinking fund, or from maintenance account, for all renewals and replacements during the currency of the loan, of plant, machinery, and works. This loan is required for the provision of a generating station within the borough. The County Council has also sanctioned a loan for 38 years of £48,545, the estimated cost of bringing existing plant into working order, and a loan for 10 years of £44,850, for meters or alterations to existing meters consequent on change of pressure. All these loans are in addition to the loan of £1,212,000 already incurred to pay the Metropolitan Electric Supply Co. for their Marylebone property and goodwill under the arbitration award. The Finance Committee has agreed to the conditions attached to the L.C.C. loan for electric lighting.

Deptford.—The London Electric Supply Corporation has informed the B.C. of its intention to lay mains in Breakspears, Cranfield, Glenadale, and Wickham Roads.

Hackney.—The Finance Committee has passed estimates for £2,121, the cost of substituting electric street lighting for gas in certain thoroughfares.

Battersea.—The Lighting Committee of the B.C. has taken into consideration the loss of £779 incurred on the street lighting during 1903-4, and has decided in favour of increasing the charge per lamp per annum on the 356 arcs, from £16 to £18 each. Mains extensions at £119 were sanctioned, and £317 is to be expended on mains to cope with the demand in the St. John's Hill and the Rise district. Application is to be made to the L.C.C. for an electric light loan of £11,355.

Londonderry.—On Thursday, 8th inst., the private electric lighting installation was switched on. The ceremony took place at the station, in presence of the Mayor and Corporation. The new plant has cost some £35,000.

The contracts for cables, engineering work, and machinery in connection with the new works amounted to £20,065, the buildings costing £6,665. The new engine house, 75 ft. × 50 ft., is situated besides the old one (used for the public street lighting plant), and contains two 375-H.P. engines, two 155-H.P. engines, two boosters, and a balancer, &c. The old boiler house has been added to and contains five Lancashire boilers. A coal store is provided, capable of holding 1,500 tons, and having a suitable quay frontage. A new pump house has been built, containing electrically-driven pumps, taking their supply from the river. A battery room has also been provided, and contains 268 cells.

Morpeth.—A L.G.B. inquiry was held on the 2nd inst. into the application of the T.C. for sanction to the letting on lease of a piece of land to the Northern Electricity Supply Co. for the purpose of erecting a power station thereon.

Newport.—The Corporation has under consideration an inquiry from Messrs. Cordes (Dos Works), Ltd., for a supply of electrical energy for power purposes at their works, estimated at 1,400,000 units per annum. The Committee resolved that the company be offered the supply at the scale rate, which the Committee considers is the lowest it can charge.

Portpatrick.—The electric light was inaugurated recently in the town and the roads of the vicinity. Lady Orr-Ewing, of Dunskey, switched on the light from the distributing station.

Sheffield.—Mr. S. E. Fedden, general manager and engineer to the Corporation electricity undertaking, has issued a postcard with a view to demonstrating to consumers the saving that can be effected by using only high grade lamps, and also pointing out the loss of light and efficiency resulting through not changing the lamps from time to time.

Southampton.—The financial results of the working of the Corporation E.L. undertaking for the year ended March 31st last are given below in brief, together with the corresponding figures for the previous 12 months:—

	1904.	1903.
Revenue, private lighting	£13,312	£13,494
,, public lighting	1,717	1,740
,, traction purposes	12,172	8,145
,, meter rents and sundries	438	450
Total	£27,639	£23,829
Total working costs, including public lighting	£14,352	£11,891
Interest	£4,560	£3,773
Sinking fund	£4,144	£3,897
Balance transferred to appropriation account	£4,583	£4,268
Total working cost per unit	1·642d.	1·647d.
Inclusive average price obtained per unit	3·174d.	3·301d.
Total number of units sold	2,089,779	1,732,013
Maximum load recorded	1,235 kw.	1,263 kw.
Total capital expended	£172,966	£138,259

Stourbridge.—The T.C. has resolved to take no further action in the promotion of an E.L. order for the parishes of Redmore, Hagley, and Clent.

Tottington.—The Lancashire Electric Power Co. has informed the U.D.C. that it intends applying for a prov. order for electric lighting, and the Council has decided to take no action in the matter.

Whitstable.—Messrs. Callender & Co. have communicated with the T.C. regarding the introduction of the electric light into the district, and the Council has resolved to hold a special meeting to interview the company's representative.

Wood Green.—The L.G.B. has written to the Council stating that it has fully considered the report made by its inspector after the inquiry held in reference to the Council's application to borrow £43,200, since increased to £43,570, and stating that it appears very doubtful whether the scheme, if carried out, would be likely to prove a financial success. The evidence given as to the probable demand for energy was unsatisfactory. The Board considers that the Council should obtain more reliable information, and that it is not convinced that the Council are acting prudently in the matter, and has recommended that the whole question, including the methods of supply, be reconsidered by the U.D.C.

Worthing.—The resident electrical engineer has been directed to report as to how, and at what cost, the lighting of the Broadway, Brighton Road, can be improved.

TRAMWAY AND RAILWAY NOTES.

Belfast.—The Tramways Committee on the 8th inst., discussed with Mr. Andrew Nance (manager of the tramways), Mr. H. A. Cutler (city surveyor), and Mr. V. A. H. M'Cowen (electrical engineer) the steps which should be taken in connection with the electrification of the system, so as to ensure as much expedition as possible. It is stated that a resolution was adopted requesting Mr. Nance, Mr. Cutler, and Mr. M'Cowen to prepare a draft specification giving full details of the work required to be done, and to submit this to the Committee at an early date, after which the question of contracts will be considered.

Bolton.—Out of the tramway profits, £2,260 8s. 8d. has been voted in aid of the rates.

Canada.—The report of the Canadian Government, just issued, shows that, up to June 30th, 1903, there were in the Dominion 759 miles of electric lines, as compared with 19,836 miles of steam railways. Two-thirds of the trolley lines are confined either to municipal ownership, or are in the hands of four companies.

Durham City.—At a meeting of the T.C. on the 7th inst., it was reported that the B.E.T. Co. intended to apply for an extension of time for laying the proposed tramway from Durham to

Brandon, till October next. It was agreed that the Council should not object if the company entered into an undertaking to proceed with the work.

Glasgow.—The cross-connecting route from Stobcross Ferry to Kippochhill Road was opened on Tuesday.

G.N. and Brompton Railway.—In regard to the claim of Mr. John Murray against the Great Northern, Piccadilly and Brompton Railway, the arbitrator is reported to have awarded £18,111. The amount claimed was £25,000.

Handsworth.—A deadlock has now occurred on the recently-electrified line from New Inns to West Bromwich boundary, the Handsworth District Council refusing to allow the South Staffordshire Tramways Co., Ltd., to use the lines until the agreement between them, as to rental and other payments, has been signed by the company. The company retaliate by saying they will claim compensation for loss of traffic during the period covered by the present delay. It is stated locally that the company are to blame in the matter, as the lines have been completed since July, the Council having carried out the work. The line in question is about 1 mile long, and connects the cable trams from Birmingham to the electric service in West Bromwich.

Hong Kong.—The new electric cars commenced running for public service on July 30th, the first car being driven by Mrs. Jones, wife of the Acting Director of Public Works. Mrs. Jones was instructed in the duties of her new position by Mr. J. Gray Scott, the general manager of the system, who, it will be remembered, went from Croydon municipal electricity works some months ago in order to take office at Hong Kong.

Jarrow-on-Tyne.—At the meeting of the T.C. on the 8th inst., Alderman Handyside asked if nothing could be done to induce the tramways company to push on with the electric tramways in the borough. Last winter the excuse was that during the depression the company could not do the work, and now the summer was almost gone, and a start had not been made with the laying of the rails, excepting on some waste land on the south side of the Don. The Mayor (Mr. Malcolm Dillon) reminded that Council that they stopped the work some time ago, and that being so they could not now take up a strong position in pressing the company. Ultimately it was resolved that the company should be written to and asked to proceed with the laying of the rails at once.

Leeds.—With the object of giving the tramway employés an opportunity of acquiring more knowledge of electricity than many of them at present possess, the Tramways Committee has approved of a proposal for a special evening class on electricity for the men at the Leeds Institute. The Committee offers to pay the sessional fee of 5s. for all who enter and put in a reasonable number of attendances.

Leicester.—On 5th inst. the Aylestone Road section of the electric tramway system was opened. Work on the uncompleted routes is proceeding. The permanent way of the Evington section has been finished and the poles erected. On the Humberstone Road section the permanent way has been almost completed. At Great Central Street and Groby Road the work is also proceeding apace.

Liverpool.—Notice of a motion has just been given by Councillor Byrne which relates to a new application of electricity in Liverpool. He suggests that the Electric Power and Lighting Committee shall be instructed to report on the practicability and cost of placing electric capstans at the top of Park Street, for hauling wagons or other conveyances from the main thoroughfare on the line-of-docks to Park Road, or other points between the docks and Park Road. Park Road is the main north-and-south thoroughfare and has a double electric car-track. The docks lie from one-quarter to one-third of a mile west of Park Road, and are at a lower level. There is considerable heavy haulage between the docks and streets lying within a third of a mile of the docks to the east, in which there are extensive blocks of warehouses. Of late trade in this part of the city has been quiet. The intention underlying Mr. Byrne's proposal is to improve trade in the locality by affording the facilities of electric rope haulage for heavy road traffic.

Liverpool — Southport Railway. — It is reported that on Tuesday night at Chapel Street Station, Southport, the terminus of the electric line to Liverpool, a large wooden erection coated with tar, and some passenger carriages near it, caught fire. An electric train some distance off was also scorched, but the current was switched off at once. Some spectators had narrow escapes from being electrocuted in their eagerness to witness the fire.

New York City.—A New York correspondent says:—"The subway, on September 5th, was well advanced towards opening, all the equipment actually necessary for running trains being finished, and the power having been turned on permanently for the third rail on September 1st, when experimental trains for training the motormen and conductors were put into operation. The work of protecting the third rail has yet to be done, as well as a large quantity of detail work at the stations. A number of steel-clad cars have been put on the rails, together with the copper-sheathed cars, as originally designed, there being altogether 800 cars in readiness for traffic. The western spur of the subway extends to 145th Street, and the tunnel under the Harlem River, which will connect the subway with the northern parts of the city, has been completed so far that a person could walk through it. The New York, New Haven, and Hartford Railroad announce a proposed expenditure of $8,000,000 (£1,608,907) for the construction of a six-track line from New York City to New Rochelle, a suburb about 20 miles north. Four of the six tracks are for electric traffic.

"Brooklyn.—The annual report of the Brooklyn Rapid Transit Co. admits that, during the year ended June 3rd, no fewer than 87 persons were killed and 294 seriously injured on its lines; 80 of the fatalities were upon the Brooklyn Heights section."

Rosario.—The *Review of the River Plate* says that the Cia. Alemana Transatlantica de Electricidad, in connection with Messrs. Dick, Kerr & Co., of London, have applied to the Rosario Municipality for a permit to electrify all the existing tramway lines in that city. A concession for 99 years is asked for. The new company will buy out the rights of all the existing lines in Rosario.

South Shields.—At a meeting of the T.C. on the 7th inst., the question of leasing or working the tramways which are to be constructed was again, in part, raised, when Councillor Wylie proposed that a resolution passed by the Council a year ago, which deferred the question of working or leasing on the tramways until the Committee had made full inquiries as to the best terms they were likely to obtain, should be rescinded. He pointed out that there had been great delay, and that there was only about 17 months of the present lease to run, and he thought it would be better if the matter were settled. Councillor J. W. Henderson seconded. There was some discussion, but ultimately the motion was lost. A second motion by Councillor Wylie that the Council should work the tramways themselves was consequently not gone into.

Torquay. — The Dolter Electric Traction Co. have written to the town clerk asking to be furnished with the probable date when the Corporation will be in a position to supply them with electric current for the tramways.

Tramway Bills.—There is no falling off in tramway enterprise, judging from the completed returns just issued by the Board of Trade as to the outcome of Parliamentary proceedings during the past session respecting orders under the 1870 Act. The number of applications was 15, and, with the exception of a couple that were withdrawn, all were acceded to by Mr. Walter Long's Department, and confirmed by St. Stephens. It is significant also that all the applications, save two, were made by local authorities. These statistics do not, of course, include private Bills promoted directly either by companies or public bodies. The total number of applications made under the 1870 Act is now 609, of which 464 were agreed to by the Board of Trade, and 444 confirmed by Parliament. —*Financial Times.*

West Bromwich.—The dispute between the Corporation and the Tramways Co., which at one time threatened to result in costly litigation, has now been satisfactorily settled. Terms were arranged between representatives of the Corporation and the Tramways Co. at a private conference on Friday in last week, and the lease was then signed. At the same time, the company handed to the Corporation a cheque for £8,000, the amount due for rent and electricity, from the time the trams commenced running in West Bromwich, to the end of June last. An agreement has now been entered into upon a basis affecting the cost of the maintenance of the track, and this is to remain in force for five years. There seems no reason now, says our local correspondent, why the trams between the Albion football grounds and the New Inns, Handsworth, should not commence running immediately.

Wolverhampton. — On Monday Alderman Mander (chairman of the Tramways Committee) intimated that from April 1st to the end of August the receipts from the trams had been very nearly £5,000 more than in the corresponding period of last year; 73,000 more miles had been run, and over 1,000,000 more passengers carried. The receipts per car-mile were over ¾d. more than last year. Up to the end of August the receipts were practically 1s. per car-mile, as against under 11¼d. last year.

TELEGRAPH AND TELEPHONE NOTES.

Colombo Telephones.—Mr. P. T. Macnamara, the acting superintendent of telegraphs and electrician in Ceylon, in his report on the telephone service of Colombo during 1903, says that the entire reconstruction of the telephone system and the provision of properly balanced metallic circuits effected such an improvement as was naturally expected when the Department purchased the system of the Oriental Telephone Co. as a going concern, but he does not consider the telephone system of Colombo is fully equal to the requirements of the community. Much has been done to save expenditure by nursing the apparatus, which, though still efficient, is not so modern as the public expect. "The charges are too high to expect any development of the system amongst occupiers of private bungalows. Furthermore, any development is hampered by the position of the present exchange, all avenues to it, through the Fort, being so crowded with wires, that further extension on existing lines is out of the question. It is hoped to formulate shortly a scheme for improving and developing the existing service at as low a cost as possible. The number of subscribers of all classes has increased from 196 to 216, the number of instruments in use from 228 to 250, and the length of wire in use from 308 to 354 miles. The revenue showed a satisfac-

tory increase of R1,668 on the revenue of last year. The profit on the year's working was R5,617·87, being 3·86 per cent. on the capital, R145,320·02. In regard to the number of calls on the exchange, there were 161,313 in 1903, as against 109,465 in 1902, an increase of 51,848, or nearly 68 per cent."

Swansea Telephones.—The Telephones Committee has taken counsel's opinion regarding the Corporation's demand for inter-communication with the National Telephone Co.'s system. It is held that in all essential points the Corporation "was certain to succeed in any litigation that was taken." A letter had been received from the N.T. Co. stating that, "as the company had no desire to adopt an obstructive attitude, it was prepared to accept the Postmaster's certificate to waive the exhibition of agreements." The questions that will now have to be decided are:—As to the plant necessary to effect inter-communication, and as to the mode in which inter-communication will have to be worked. After consideration of further correspondence, it was thought that the company's demands seemed capable of different interpretations, and it was decided to write asking for proper interpretation of the company's letter, and informing them "that the Corporation would have to resort to compulsion if necessary."

Telegrams to Alaska.—The rates for telegrams to Alaska are now:—

Haines Mission	Anglo-American Co. / Direct U.S. Co. ..	2s. 7d. per word.
Juneau	French Co... ..	
Sitka	Western Union Co..	
Skagway	Commercial Co. ..	
All other places	Ditto	3s. 10d. per word.

The Telegraph Cable Export Trade.—A very quiet tone continues to prevail in the export trade of this country in telegraph cables and apparatus connected therewith, the shipments last month only reaching a total of £50,377 as compared with £62,272 in August, 1903, in itself a quiet month. The extent of the existing depression is shown by the fact that the exports during the eight months ending with August last only amounted to £594,220 as contrasted with £1,528,466 in the corresponding period of last year, and £2,175,993 in the first eight months of 1902.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Trinidad-Demerara	Aug. 26, 1901 ..	..
Dominica-Martinique	May 7, 1902 ..	..
St. Lucia-Martinique	May 7, 1902 ..	..
Cayenne-Pinheiro	Aug. 13, 1902 ..	..
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Closed { Vladivostock-Nagasaki	Feb. 9, 1904 ..	..
Closed { Port Arthur-Chefu	Mar. 9, 1304 ..	..
Paramaribo-Cayenne	July 18, 1904 ..	..
Cape Haitien-Mole St. Nicholas	Aug. 20, 1904 ..	..
Bundaberg-Gomen (New Caledonia)	Aug. 30, 1904 ..	..
LANDLINES.		
Cartagena-Baranquilla	Dec. 8, 1900 ..	..
Puerto Bairros	July 28, 1902 ..	..
Seoul-Masampo	Feb. 18, 1904 ..	..
Seoul-Gensan	Feb. 18, 1904 ..	..
Anju-Ping-Yang	Feb. 25, 1904 ..	..
Ninguta-Vladivostock	March 2, 1904 ..	..
Caimanera-Santiago	June 15, 1904 ..	..

The Telephone Service.—The D.C. of Enfield, which has complained from time to time of the entire absence of telephonic communication in its area, has received a reply from the G.P.O., in which it is explained that, "owing to the pressing need for providing telephone facilities in other parts of the London Telephone Exchange area, it has not yet been practicable to consider the question of extending the Post Office telephone system" to Enfield Wash and Highway. The secretary of the G.P.O. says that "he has been in communication with the National Telephone Co. regarding the needs of the neighbourhood, and . . . . that company has informed him that it is about to take active steps with a view to the extension of its system to the district." It is added that, as there is intercommunication between the G.P.O. and the N.T. Co.'s systems in the London area, "the extension of the company's system should, therefore, afford as full telephonic facilities as the Postmaster-General himself could offer."

Wireless Telegraphy.—A Reuter dispatch from Rome, dated September 8th, says that the Italian Government has obtained permission from the Chinese Government to establish wireless telegraphic stations in Chinese territory.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen. — September 27th. Twenty top-deck car covers, for the Tramways Committee. See "Official Notices" September 2nd.

Ballinasloe.—September 17th. A set of accumulators (110 cells, having a capacity of not less than 342 amp.-hours, and a maximum discharge rate of not less than 60 amps.) for the Joint Committee of the District Asylum. Tenders to the Resident Medical Superintendent. The Committee will consider the tenders on Monday next, September 19th.

Bangour Village.—September 28th. The Edinburgh District Lunacy Board invite offers for the following works:—(1) Electric wiring and cables; (2) telephone installations; (3) electric bells, required in connection with certain buildings erected and to be erected at Bangour. The specification may be obtained from the architect, Mr. H. J. Blanc, 25, Rutland Square, Edinburgh.

Barking Town.—September 20th. Rails, permanent way, overhead equipment, and feeder cables, for light railways extensions. See "Official Notices" August 26th.

Bolivia. — January 15th, 1905. The municipal authorities of La Paz are inviting tenders until January 15th for the concession for the electric lighting during a period of 12 years.

Burton-upon-Trent.—September 22nd. Steam piping for the electricity works. See "Official Notices" September 9th.

Bury.—September 26th. The Guardians want tenders for electric wiring, bells, and telephones for the new hospital buildings. Mr. G. R. Peers, 16, John Dalton Street, Manchester, consulting engineer (specifications, one guinea).

Edmonton.—September 27th. The U.D.C. invites offers from companies willing to carry out its electric lighting provisional order. See "Official Notices" August 26th.

France.—September 29th. The municipal authorities of Paris are inviting tenders, until September 29th, for the supply and erection of a gas engine and dynamo of a capacity of 7 KW. at the municipal electric lighting station at the Square Saint Pierre. Particulars may be obtained from, and tenders are to be sent to, l'Hotel de Ville, Paris.

Holland.—September 22nd. The municipal authorities of the Hague, Holland, are inviting tenders, until September 22nd, for the supply of 8,000 to 9,000 tons of steel rails for electric tramways.

Ilford.—October 4th. Balancer and switchboard panel; reversible booster and panel, for the U.D.C. See "Official Notices" to-day.

Isle of Thanet.—Stores for the Isle of Thanet Electric Tramways and Lighting Co. See "Official Notices" September 9th.

Leyton.—September 23rd. Electric wiring and fittings for Newport Road School. See "Official Notices" September 2nd.

Limerick.—September 17th. Water tank, electrically-driven pump, piping, &c., for the electricity works. See "Official Notices" to-day.

London.—October 4th. Three electric car traversers for the L.C.C. See "Official Notices" August 5th.

London.—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

Philippopoli.—October 2nd—15th. The Municipality is inviting proposals for the installation of electric lighting and tramways in the town. A copy of the official announcement in French will be found in the *Times* for September 5th. M. Penkoff is the chief of the technical section.

Richmond.—October 5th. Pumping machinery and electric motors for the Sewerage Board. See "Official Notices" to-day.

Roumania.—Tenders are about to be invited by the municipal authorities of Giurgin for the electric lighting of the town.

Servia. — October 2nd. Tenders are invited until October 2nd, by La Société Oratschar et Kablar, at Tchatschak, Servia, for the supply of two sets of turbines and dynamos for their central electric lighting and power station.

Salford. — October 6th. Lead-covered cables for the Electricity Committee. See "Official Notices" to-day.

Shanghai.—March 31st, 1905. The Board of Trade have received through the Foreign Office a copy of a telegram from the British commercial agent in Shanghai to the effect that tenders are invited by the municipality of that city for the construction and working of 24 miles of electric tramways on the trolley system, double or single. Conditions, plans, &c., on application to Messrs. Pook & Co., agents for the municipality of Shanghai, 63, Leadenhall Street, E.C.

Spain.—September 25th. The municipal authorities of Arenas de San Pedro (Province of Airla), are inviting tenders for the concession for the electric lighting of the town during a period of 8 years. Tenders are to be sent to El Secretario del Ayuntamiento de Arenas de San Pedro (Airla), whence particulars may be obtained.

Tynemouth.—September 30th. One 600-KW. steam dynamo for the Corporation. See "Official Notices" September 9th.

CLOSED.

Bootle.—The T.C. has accepted the tender of Messrs. Hughes & Stirling for alterations and additions at the E.L. station.

Brighton.—The tender of the St. Helens Cable Co. for the supply of low tension cables, conduits, boxes, and meters for the parish of Aldrington, at £7,113, has been accepted by the T.C.

Hackney.—The E.L. Committee has placed an order, at £1,200, for cables with the British Insulated and Helsby Cables, Ltd.

Newport (Mon.).—The Electricity and Tramways Committee has accepted the tender of Messrs. Dorman & Smith (£123), for an arc lighting switchboard with four panels.

Plymouth.—The T.C. has accepted the tender of Messrs. W. J. Corse & Co., for the wiring of the Western Law Courts for the E.L., at £89 10s.

Salford.—The T.C. has accepted the following tenders in connection with the E.L. and tramway undertakings:—

Geo. Leek & Sons, Ltd., iron castings.
Heap & Co., wiring Pendleton Town Hall, and wiring platform
Rock Bronze, Ltd., trolley heads and trolley wheel globes.

Southport.—The Corporation Electricity Committee has accepted the tender of Messrs. Procter & Co., for the supply of mechanical stokers, at £219.

Whitby.—The U.D.C. has placed contracts with Callender's Cable Construction Co., and the Cable Accessories Co., for requirements on account of electricity extensions.

Worthing.—The T.C. has accepted the tender of Messrs. Danks & Co., of Oldbury, for the supply of new flues for the boilers at the E.L. works, at £110.

U.S.A.—A New York correspondent sends the following:—

Pittsburg, P.A.—The Westinghouse Machine Co. has a contract to equip six of the express trains between New York and Boston with a new system of electric lighting.

Ohio.—The Westinghouse Electric and Manufacturing Co. has entered into a contract to equip 110 miles of line from Fort Wayne, to Springfield and from Indianapolis to Cincinnati, with its system of single-phase alternating current electric traction.

FORTHCOMING EVENTS.

September 27th, 28th and 29th.—Municipal Tramways Association of Great Britain. Annual Conference to be held in Liverpool. Full particulars were given in our "Notes" in September 9th issue.

NOTES.

The I.E.E. Visit to America.—A New York correspondent, writing under date September 5th, says that the ss. *Republic*, with the party of members of the Institution of Electrical Engineers, arrived at Boston early on the morning of Saturday, Sept. 3rd, after a pleasant voyage. Later in the day the party visited the generating station of the Edison Electric Co., and saw, among other things, the big 5,000-kw. generator which was recently installed. A visit was also made to the famous Boston Institute of Technology. At the invitation of Dr. Kennelly, chairman of the St. Louis electrical convention, a visit was also made to Harvard College, where the party was entertained at lunch by the Harvard Union. The journey to New York was accomplished on the Fall River steamer *Puritan*, which left Boston on Saturday evening and reached New York City at 6.45 on Sunday morning. On stepping off the steamer, the members of the party were escorted to electric motor-cars and driven to their respective hotels, while their luggage was taken after them on two 4-ton electric wagons, lent for the purpose by the New York Edison Co. On Sunday afternoon, by the kindness of Mr. J. G. White, of the firm of Messrs. J. G. White and Co., the visitors including a number of members of the Associazione Elettrotecnica Italiana, also on their way to St. Louis, were taken for a trip on the Hudson River, and in the evening went down the Bay to Coney Island, ostensibly for the purpose of seeing the electrical plant at "Dreamland," a popular resort of a character entirely unlike any other place in the world. A feature of "Dreamland" is a tower, constructed last March, 300 ft. high, and illuminated at nightfall by means of 100,000 incandescent lamps.

On Monday morning the party first made a trip through the New York subway, by the courtesy of the contractor, Mr. John B. Macdonald, and spent the remainder of the day in visiting the large power stations in and around the city. In the evening a banquet was given in honour of the visitors at the Waldorf Astoria Hotel. On the following morning the party left for a circular tour, comprising the works of the General Electric Co., at Schenectady, and thence to Montreal, Niagara Falls, Buffalo, Chicago, and St. Louis; and they were expected to reach New York again, *vid* Philadelphia, on September 13th.

Ageing Experiments on Transformer Stampings.—In a recent number of the *Electrotechnische Zeitschrift* (No. 24), there is a record of the ageing experiments on sheet-iron carried out by the Hysteresis Committee, the results warranting the following conclusions:—New transformers will sometimes, after some months' stay in the laboratory, even at ordinary temperature, give higher losses than in the beginning, whereas the losses of the checking transformers used in connection with the experiments during an investigation of 2½ months did not show any further change, so that it would seem as if the loss coefficients at ordinary temperatures increase only for a certain time after completion, becoming constant afterwards. Excepting one of the sheets examined, all showed an ageing tendency, the ageing effect being, however, generally very small (3 to 8 per cent.). A strong ageing effect, however, was observed in alloyed sheets, being higher in one containing 2 per cent. of Al. (33 per cent.) than in one containing 1 per cent. of Al. (viz., 15 per cent.). The increase of the loss coefficient was always due to an increase of the hysteresis loss, while the loss produced by Foucault currents was generally found to remain constant. The figures found statically generally agree with those found by a wattmeter method.

An Electric Smelting Furnace.—M. Imbert de Vanoy has designed an electrical furnace for smelting copper in Chili, which has been tried successfully at Issy-les-Moulineaux, France. The arcs are produced by carbons 10 centimetres in diameter, giving a temperature of 3,000° C. The furnace is reverberatory, and utilises the radiant heat continuously without direct contact with the electrodes. The current required is 2,000 amperes at 110 volts, and a ton of ore per hour calls for 440 kw.

Works' Visits in the Newcastle District.—The members of the North of England Institute of Mining and Mechanical Engineers are holding their excursion meeting at Newcastle-on-Tyne from September 19th to 23rd inclusive. The list of arrangements which have been made for visits to works and collieries is, we think, one of the finest that we have seen. The electrical features of the meetings include visits to the Carville and Neptune Bank power stations of the Newcastle-upon-Tyne Electric Supply Co., the Manors power station of the Newcastle Corporation tramways, sulphur recovery plant at the Alhusen Works of the United Alkali Co., Ltd., and the N.E. Railway Co.'s transforming and other works connected with the electrified routes of their system. The other visits are to the works of Palmer's Co., Armstrong, Whitworth & Co., Swan & Hunter's, and numerous other engineering, iron, and steel manufactories in which the district abounds.

The Gurwitsch Process for Electrolysing Alkali Chloride Solutions.—W. Kettembeil and C. F. Carrier, jun., have recently examined (*Zeits. Elektrochemie*), 1904, x., 561) the process patented by Gurwitsch for the electrolysis of aqueous solutions of alkali metal chlorides, in which the cathode is an upright or sloping sheet of iron provided with closely spaced grooves, over which mercury is constantly trickling. Kettembeil finds that the iron plates are very difficult to amalgamate completely, that they must always be kept under current, that considerable losses occur through the decomposition of the electrolyte caused by the fine state of division into which the motion of the mercury reduces that metal, that (especially when no diaphragm is employed) the yield is not constant at a cathodic current density of 0·25 ampere per square centimetre, and only becomes so when the density reaches 0·388 ampere; that when the anode is placed within a porous cylinder, the yield can hardly be brought to exceed 85 per cent. of the proper amount, and that, without such cylinder, it is only 50 per cent. If the rate of motion of the mercury is reduced, the output falls off, and nickel electrodes give no better results. Carrier finds that, when no diaphragm is used, the chief cause of the low yield is not the movement of the liquid, but the rapid motion of the mercury; so that, unless a diaphragm is employed, a good yield can only be obtained if the mercury is at rest or moves slowly and regularly.

Electrolytic Preparation of Chlorates.—Siemens and Halske have taken out a German patent for the manufacture of chlorates by the electrolytic decomposition of chlorides according to a process in which the essential feature is the addition of fluorides to the bath. When, for instance, a solution of sodium or potassium chloride is electrolysed in the warm without a diaphragm in the presence of fluorides, not only is the total yield of chlorine much higher than in their absence, but also the yield of chlorate is much larger. The amount of hypochlorite produced is very small, by far the greater part of the active chlorine passing into solution as chlorate, and crystallising out (if the metal is potassium) as the electrolysis continues. The best results in the electrolysis of alkali chlorides are obtained by adding the fluorine in the form of hydrofluoric acid, or by arranging that hydrofluoric acid shall be produced within the liquid; and it is advisable to make the addition gradually so as to avoid loss by volatilisation.

Radiant Efficiency of the Nernst Lamp.—Mr. L. R. Ingersoll has published in the *Physical Review*, Vol. 17, No. 5, particulars of some experiments made by him to determine the radiant efficiency of Nernst lamp glowers. The latter were made by the Nernst Lamp Co., of Pittsburg, for 110-volt circuits, and consumed 89 watts each. New glowers showed a radiant efficiency of 4·61 per cent., falling during the first 20 hours to 4·3. Glowers 40 hours old and upwards gave 3·9 to 4·4, and some very old ones 3·6 per cent. From the results the temperature of the glowers is estimated at 2,360° C.

A Possible Cause of Balloon Explosions.—The *Technische Wocke* suggests that the explosions of balloons just on reaching the ground may be accounted for electrically. The balloon, when floating free in the air, and consequently insulated from earth, may store up electricity generated by the friction produced on throwing ballast out. As soon as the balloon reaches the ground, this quantity of electricity may give rise to a spark sufficient to start the explosion. This idea would seem to be confirmed by the following simple experiment. A basket of any shape is taken to represent the balloon, and from it is suspended, by means of silk threads, an iron box full of very dry sand. The box is connected to an electroscope. If now the sand is allowed to flow out, the gold leaves will be seen to separate, and it is not unlikely that, if the experiment were continued long enough, a spark would be obtainable.

An Air Brake for Motor Testing.—M. C. Renaud recently described before the Académie des Sciences a simple form of absorption brake which he has successfully employed for some years. The brake consists of a straight wooden bar fitted with a boss in the centre for attaching it directly to the motor or engine shaft, and with two rectangular aluminium blades fixed at equal distances from the centre, and with their faces at right angles to the plane of revolution. These blades can be fixed in numbered holes provided for the purpose at regularly increasing distances from the centre, and thus permit a single brake to cover a large range of powers and speeds. The power absorbed is found to vary directly with the square of the angular velocity, so that it is only necessary to determine the constant, by means of a transmission dynamometer, for each position of the blades, and a complete set of parabolas can be drawn from which the power corresponding to each speed and blade position can be read off directly, only speed readings being thus required for measuring powers. Such a diagram is provided with each brake, and this diagram also shows the limiting safe speed for each position of the blades, as well as the small corrections necessary for changes in atmospheric temperature and pressure above or below the normal. The apparatus does not heat, as the power is absorbed by masses of air which are constantly being renewed, so that tests can be continued for any length of time without risk of trouble. The dimensions of the brakes are small—one capable of absorbing 20 H.P. or more only weighing 2 kg. Powers of from 1 H.P. up to 150 H.P. have been successfully dealt with up to the present, and there seems to be no difficulty in dealing with considerably greater powers.

A Safety Device for Overhead Lines.—Experiments have recently been made at Evian-les-Bains, according to the *Revue Industrielle*, on the prevention of danger through the breaking of H.T. overhead lines. The method employed is due to M. Giraud, and depends on the difference in tension on the two sides of the support as soon as a break in the line occurs on one side of it. In one form a projecting hook is clamped to the line wire on each side of the support, and when the break occurs one of these hooks is dragged along and comes into contact with a long swinging arm, which it forces up and into contact with the other line (or with earth), and so short circuits the section of the line, and actuates an ordinary automatic circuit breaker. Another form consists in suspending the line from an insulated pivoted arm. So long as the line is intact, the arm is held in the mid position, but as soon as the line breaks on one side, the arm is pulled round to the other, and comes into contact with an earth plate, thus again actuating the automatic cut-out. Various other modifications are described, and are said to have worked excellently during the experiments.

The Other Side of Dumping.—The *Standard* of September 13th criticises the statement of the Tariff Commission, that dumping is part of an organised policy, and shows, by evidence brought before the official inquiry into German Kartells that is now in progress, that dumping, especially of what the Germans call "half-stuff"—*i.e.*, "halbstoff"—is rather part of a very much disorganised policy. The organised policy is the keeping up of prices to the home consumer, who, as a manufacturer of finished goods, bitterly complains that the British and the Belgians, who work up the artificially cheapened half-stuff, are able thereby to oust German finished goods in neutral markets. It is not denied that the manufacturers of half-stuff have been helped by dumping, because, no doubt, it has put them in funds, just as a hard-pressed dealer may sell furniture at a third of its value, so as to keep himself out of the court. The managers of the Half-stuff Union attributed dumping to the fact that only home trade prices were controlled, and the various firms entered into wild competition in the open foreign markets. It was pointed out that the effect of dumping was cumulative. The finished trade, when demand at home fell off, also tried to enter foreign markets, and met there a competition much harder to meet because of the help given to finished foreign-made goods by the dumping of half-stuff. Thus the German finished goods trade was doubly mortified, first, by having to pay a long price for its raw material or half-stuff; and secondly, having to compete against goods made from excessively cheap half-stuff. And the excessive cheapness was made possible by the enhanced home price. One wire manufacturer stated that the export bounty on wire was now—October, 1903—not enough, and . . . . "the German wire industry will be ruined by this preposterous policy, '*i.e., dumping*,' of the Half-stuff Union. Another witness complains to the same effect, and adds that Belgian finished products, formerly of low value, have improved in quality, because cheap German steel can now be employed. Unless the Half-stuff Union will come to an agreement with the works using its products, it is threatened by this witness with" our endeavours o abolish tariff on half-stuff.

Similar complaints are quoted from a director of a sheet-rolling mill who is in the Fine Sheet Union, and from the locomotive builders. All the complaint is of dear raw materials. In shipbuilding, the Dutch, who do not produce iron at all, and have no coal, were offering barges and other river boats at less than German prices—at less, in fact, than the cost to the German builders of raw material. This trouble had to be settled by admitting raw material free to the river shipyards.

The machinery makers tell the same tale of cheap sales abroad, owing to competition of machinery made of dumped stuff from Germany. A difference of less than 1½ per cent. lost orders in Holland with "good old customers," yet 100 marks per wagon of iron would have swamped this difference, and the Dutch are buying German iron at 100 marks per wagon under German prices to Germans. Everywhere a similar story is told of the injury to German trade through dumping raw material, *i.e.*, semi-finished goods or half-stuff at under cost price. These comprise mainly pig-iron, raw steel or billets, and rolling mill products, which have been sent abroad "in pursuance of the desperate policy of an almost bankrupt industry devoid of organisation in the export trade."

There appears very little reason to fear a permanence of dumping at slaughter prices, and only a recurrence under a similar period of stress. The new steel combine seems already to have been able to put a stop to dumping, and all the proceedings of the Kartell Inquiry point to the opinion held by the leaders of the Pig-iron and Half-stuff Unions that dumped exports must be stopped.

Meanwhile, it is very doubtful whether any evidence can be advanced to show that this country has suffered from these gifts of cheap raw material. That iron manufacturers have had to wake up a bit, is, perhaps, no bad thing. When thoroughly awake they can easily look around and find huge wastes in progress that if stopped would mean dividends. The more this question is examined the less dreadful does the policy of dumping appear when considered in relation to British industry.

South African Notes (from our Durban correspondent).—*Bethlehem* (*Orange River Colony*).—Messrs. Harris, Lee & Co. electrical engineers, of Johannesburg, have secured the concession for the electric lighting of this town, on similar lines to the Heilbron installation, which is now well in hand.

Middleburg (*Transvaal*).—The Town Council of this town has under consideration a scheme for electric lighting of the cantonments only. This will be distinct from the works now in hand.

Johannesburg (*Transvaal*).—The Town Council on August 5th approved the expenditure of £143,169 6s. 4d. for tramway and electric light cables, the two lowest tenders being accepted, viz.:—Messrs. Glover's tender for A., B., and C. sections, amounting to £106,377 18s., for underground cables; and the British Insulated and Helsby Cable Co.'s tender for D. section, amounting to £10,789 17s., for trolley wires and bare overhead L.T. mains—the difference between their combined sums and the total mentioned being allowed for transit charges in connection therewith.

Durban (*Natal*).—The technical education movement is exciting much interest in Durban just now; and on August 16th, Prof. Hele-Shaw delivered an interesting lecture to an appreciative audience on "Road Locomotion." On the following day he held a conference with the leading men of the town and others interested in the movement, which resulted in a resolution being passed to accord it support when arrangements have been made for the establishment of technical schools. Prof. Hele-Shaw left on the following day for England, where he will make his report.

Transvaal.—The Colonial Secretary of the Transvaal recently laid on the table the report of the telephone branch of the Post and Telegraph Department, which showed that the revenue amounted to £40,075 3s. 11d. for the year 1903-1904, while the expenditure amounted to £25,509.

Cape Colony.—The returns for the Cape telegraphs for year ending June 30th, 1904, give the total messages as 2,271,000 for public purposes, and 180,945 for Government messages, the total decline as against last year being 473,000 messages. The revenue amounted to £222,109, being a decrease of £49,970.

Electric Shock Fatalities.—On 6th inst., at Messrs. Parsons's electrical works at Walker-on-Tyne, a young engineer named George Alfred Coleman was killed by electric shock. The inquest was held on the 8th inst. William Flint, a fellow workman, said that they were engaged at a turbine electrical generator for testing purposes. Deceased was to look after the readings, and witness had to attend to the speed. Witness went behind the turbo to take the readings at the request of deceased, and on coming back a minute afterwards, he found the deceased lying over the commutator, apparently dead. Witness stopped the machine at once, and as he shut off the steam the deceased fell from the machine on to the ground. Witness could not say what the deceased was doing at the machine, for there was nothing to have brought him so near it. Thomas Cockburn, assistant foreman, said he thought Coleman had been attempting to mend the cord of the speed counter when he had slipped, and come into contact with the brushes. There was a pressure of about 300 volts, and although this had been sufficient to kill the deceased, there were men in the works who had had shocks at double that pressure. Mr. Gerald Stoney said he had never known a man killed with 300 volts. He had had 4,000 volts through him, and was still alive. [Mr. Stoney might read up the back numbers of the ELECTRICAL REVIEW with advantage.] A verdict that the deceased had been accidentally killed through coming in contact with the dynamo was returned, no blame being attached to anyone.

The *Sydney Daily Telegraph* of August 2nd, says that on August 1st, a fatality occurred at the Melbourne Corporation Electric Lighting Works, in Spencer Street. A young man named

Harold W. Brice was engaged with two others in some repairing work, when he seized hold of a live switch. The switch was carrying a current at 2,000 volts. "For the moment there was a hissing sound as the arc burnt into his hands, and then Brice fell back on the floor, dead." The *Sydney Morning Herald* adds that Brice had had considerable experience at the work upon which he was engaged. One of the switches was found to have jammed, and while the repairs were being effected, the electric current was diverted, and the switch made safe to handle. The slight repair was effected, and the switch set in position. Brice stepped behind the board out of sight, apparently to make sure that everything was all right, and, in a moment of forgetfulness, placed his hands on the switch, and met instant death. Both his hands were burned to the bone in the palms, and the skin peeled off the wrists.

Determining Small Inductances by Means of Singing Arcs.—Assuming that the oscillations have a sinusoidal behaviour, Mr. Janet has given for the inductance L of a coil connected in shunt to a singing arc the expression

$$L = \frac{v^2}{i^2} C,$$

where v stands for the potential difference between the terminals of the coil, i for the current in the shunt circuit, and C for the capacity of the condenser inserted into the latter. The problem dealt with by A. Petrowski in a memoir published in a recent collection of Russian physical papers devoted to the memory of Prof. Th. Petrouchewsky, consisted in determining the conditions under which Janet's formula is true. The figures obtained for each of the various coils, on the secondary conditions of the experiment being altered, agree very well with one another, while differing noticeably from the values calculated according to the dimensions of the coil. The method should accordingly be used only for comparative measurements, the oscillations being apparently more complicated in the case in question than had been assumed.

Electrical Ore Finding.—The successes which recently marked the operations of the Ore Finding Co., Ltd., in Wales and Cornwall, when in quest of lead and copper, have apparently been repeated in Cumberland. For a long time the output of hematite in Barrow and the surrounding country has been seriously declining. In the last few years it has dropped in the case of one company from 16,000 tons a week to 2,000 tons, and before the ore-finder came on the scene, the prospect was distinctly gloomy. The companies concerned have tried their utmost to find fresh sources of supply. They have sunk numerous shafts and spent large sums in boring operations, but without any appreciable result. It was in these conditions that the electrical ore-finder was called in by the Barrow Hematite Iron and Steel Co. It was necessary in the first place to have specially-tuned instruments, because an instrument tuned to locate copper would be useless for hematite. A certain area was allotted for the test. The finder soon indicated the presence of hematite in large quantities, and the Barrow Co. decided to prove the accuracy of the divination, and boring operations at the points marked were begun. Before the work had proceeded very far the hematite formation was struck, and at a little greater depth limestone. Boring was continued, and hematite was again struck within a few feet of the depth the instruments indicated. It is stated that all the principal iron companies round Barrow intend to take up the matter and see if other new sources can be tapped.

Automobile Speeds in London.—An inquiry is to be held at the Guildhall on Tuesday, September 27th, by Mr. E. P. Burd, one of the inspectors of the Local Government Board, with reference to an application made by the City Corporation to the effect that notices should be issued under the Motor-Car Act, 1903, limiting the speed of all motor-cars passing through the City to 10 miles an hour. Certain objections have been raised against the proposed speed limit, and the object of the inquiry is to consider these.

Appointments Vacant.—The Council of the Durham College of Science, Newcastle-upon-Tyne, is inviting applications for the office of Principal of the College, rendered vacant by the death of Dr. Gurney (salary, £1,000 per annum); advertisements are about to be issued for a chief engineer and manager for the Southwark electric light undertaking (the salary is to be £300 a year, rising by annual increments of £20 to a maximum of £400); an assistant for the Meteorological Division of the Physics Department at the National Physical Laboratory (£200); chief assistant engineer (£130), clerk (£100), meter inspector, switchboard attendants, and others, for the staff of Heston and Isleworth electricity works.

Pneumatic Tubes for Parcels.—It is reported that the Pneumatic Tube Co. has opened its 18-in. pneumatic tube for package freight from Chicago to Milwaukee. The distance is covered in 40 minutes, including intermediate stations, the speed being two miles a minute. There are also smaller tubes in Chicago for local purposes.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*]

Central Station Engineers.—On Saturday last, at the Llanarth Street electricity works of the Newport (Mon.) Corporation, a presentation was made to Mr. John P. Strange, who has resigned his appointment as charge engineer in order to take up contracting work. In the absence of Mr. H. Collings Bishop, borough electrical engineer, the presentation of a handsome portmanteau was made by the deputy borough electrical engineer, Mr. L. de R. du Verge, in the presence of a large and representative gathering of the electricity department. Mr. Strange was later on presented with a silver-mounted walking stick by the engine-drivers of the works.

The following have been selected to meet the Corporation Electricity Committee at Southport in respect of the appointment of an engineer in charge at the electricity works:—Mr. E. de la Roch Rendell, Hanley; Mr. E. P. Hale, Blackburn; Mr. W. T. Bamber, Manchester; Mr. C. W. Cripps, Bedford.

Barnsley T.C. has fixed the following scale of salaries for the officials in the electricity department:—Chief assistant, first year, £150, second year, £160, third year, £170; shift engineers, first year, 30s. per week, second year, 35s.; mains superintendent, first year, 30s. per week, second year, 35s., fourth year, 40s.; improvers, first year, no salary, second year, 20s. per week, third year, 30s.

The staff and employés of the Leeds Electric Lighting Department presented Mr. W. Ainscough with a handsome timepiece and bronzes on the occasion of his marriage.

Electric Tramway Officials.—The Tramways Committee of Bradford T.C. has recommended the appointment of Mr. C. E. Hobson, as parcels manager on the tramways system at a salary of £150 per annum. There were 303 applicants for the post. Mr. Hobson has been engaged in the goods traffic departments of the Great Central and Great Northern Railway Cos.

At a meeting of the Newcastle-on-Tyne Tramways Committee on the 8th inst., a telegram was received from Mr. A. E. Le Rossignol, general manager of the Corporation tramways, tendering his resignation of his office. The matter was deferred until the following day, when a special meeting of the Tramways Committee was held to consider the matter. The proceedings were private, but it was subsequently stated that Mr. Le Rossignol had received the offer of an important and lucrative appointment abroad, and the Committee regretfully resolved to accept his resignation.

General.—Mr. F. S. Worsley, who was for about eight years with Messrs. Johnson & Phillips, and for the last 5½ years head of the manufacturing and technical departments of the Brockie-Pell Co., has now joined the staff of Messrs. Veritys, Ltd., as manager of their arc lamp department. His 19 years' experience of arc lamps should be of great service to him in his new position, for he will undertake for Messrs Veritys, Ltd., the complete control and reorganisation of their arc lamp manufactures. They are putting on the market, for the coming winter, a new enclosed lamp to burn equally well on alternating or continuous current circuits, and also a twin carbon enclosed lamp, both of these lamps being Mr. Worsley's designs. It may be added that Messrs. Veritys' arc lamp department is forging ahead, numerous and important contracts having recently been secured, including the lighting of the city of Dublin which has just been completed, and which consists of over 500 of their special double-carbon continuous current lamps.

Mr. A. J. Makower, of the alternating current designing department of the British Thomson-Houston Co., Ltd., of Rugby, has been appointed to the position of head of the electrical engineering department of the South-Western Polytechnic at Chelsea.

The death is announced, at the advanced age of 83 years, of Mr. John Thomas Pearson, of Melmerby, Yorkshire, who was one of the founders of the Yorkshire House-to-House Electricity Co.

NEW COMPANIES REGISTERED.

"Simplex" Arc Lamp Syndicate, Ltd. (82,017).—This company was registered on September 9th, with a capital of £16,000 in £1 shares, to adopt agreements (1) with A. Heller, (2) with F. W. Stevens, and (3) with C. J. Scott, and to carry on the business of manufacturers of and dealers in arc and other lamps, brackets, globes, films, shades, glasses, burners, meters, carbon, cut-outs, switches, motors, batteries, stoves, turbines, pipes, wires and all appliances and things used in connection with electricity or any other illuminant or generator of light, heat or power, suppliers of electric and other light, electrical and general engineers, &c. The first subscribers (each with one share) are:—H. L. Steadman, 4, Suffolk Street, Pall Mall East, S.W., clerk; W. B. Pearson, 4, Suffolk Street, Pall Mall East, S.W., clerk; W. T. A. Rayner, 4, Suffolk Street, Pall Mall East, S.W., clerk; G. de Horne, 86, Claverton Street, S.W., clerk; W. M. Pleadwell, 27, Nottingham Place, W., solicitor; G. H. Smith, 19, Euston Square, N.W., solicitor; and J. C. Bullen, 72, Huddleston Road, Forest Gate, clerk. Minimum cash subscription, 500 shares. The first directors are to be appointed by the subscribers; remuneration, £100 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Oil Refining Co., Ltd. (43,126).—This company's annual return was filed on August 4th, when 4,375 shares had been taken up out of a nominal capital of £5,000 in £1 shares, £882 had been received, and £3,493 was considered as paid. Mortgages and charges: Nil.

Scottish House-to-House Electricity Co., Ltd. (29,232).—A mortgage or charge dated September 1st, 1904 (supplemented to a charge dated March 31st, 1904), to secure an additional £1,250, has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, E.C.

Fladbury Electric Light and Power Co., Ltd. (63,942).—Issue on August 29th of £150 5 per cent. debentures, part of series created October 31st, 1903, to secure £800, charged on the company's undertaking and property, present and future, including uncalled capital. Holders: J. W. Wagstaff, Weston House, Fladbury, Worcs; and S. H. Deakin, Weir End, Ross, Hereford. No trustees. Previously issued of same series, £150.

Sloan Electrical Co., Ltd. (61,528).—This company's annual return was filed on August 18th, when 5,000 "A" preference, 4 "B" preference, and 2,750 ordinary shares had been taken up out of a nominal capital of £15,000 in 5,000 "A" preference, 5,000 "B" preference, and 5,000 ordinary shares of £1 each; £1 per share had been called up on 4 "B" preference, and 1,250 ordinary, resulting in the receipt of £1,254; 6,500 shares were considered as fully paid. Mortgages and charges: Nil.

Lancashire Dynamo and Motor Co., Ltd. (61,447).—This company's annual return was filed on June 30th, when 700 ordinary and 249 preference shares had been taken up out of a nominal capital of £100,000 in 700 ordinary and 300 preference shares of £100 each. £100 per share had been called up, and £94,150 had been received, leaving £750 in arrears. Mortgages and charges, nil. A list of allotments made up to July 4th shows a further issue of six ordinary shares, payable in cash, and a list made up to August 8th shows that six more were then allotted, also payable in cash.

South American Cable Co., Ltd. (34,363).—This company's annual return, made up to August 4th, has been filed. 24,707 shares had been taken up out of a nominal capital of £500,000 in 50,000 shares of £10 each. £10 per share had been called up on 14,707 shares, resulting in the receipt of £147,070. £100,000 was considered as paid on 10,000 shares. Mortgages and charges: Nil.

Sunbeam Lamp Co., Ltd. (25,498).—This company's annual return was filed on August 16th, when 1,765 shares had been taken up out of a nominal capital of £25,000 in 2,500 shares of £10 each. £10 per share had been called up on 908, and £8,080 had been received. £8,570 was considered as paid on 857 shares. Mortgages and charges: £8,400.

Electrical Power Storage Co., Ltd. (29,414).—This company's annual return was filed on August 5th, when 66 founders' and 18,592 ordinary shares had been taken up out of a nominal capital of £100 500 in 100 founders' and 20,000 ordinary shares of £5 each. £5 per share had been called up on 66 founders' and £4 per share on 3,132 ordinary shares and £14,332 5s. 1d. had been received, including £474 5s. 1d. paid on 4 founders' and 405 ordinary shares forfeited. £77,300 was considered as paid on 15,460 shares. Mortgages and charges £28,400.

Electric Construction Co., Ltd. (39,292).—This company's annual return was filed on August 10th. 31,390 preference and 112,100 ordinary shares have been taken up out of a nominal capital of £400,000 in 50,000 preference and 150,000 ordinary shares of £2 each. £2 per share has been called up on 18,245 preference and 2,100 ordinary shares, resulting in the receipt of £40,690. £246,290 is considered as paid on 13,145 preference and 10,000 ordinary shares. Mortgages and charges: £250,000.

Eastern and South African Telegraph Co., Ltd. (13,306).—This company's annual return, made up to August 5th, has been filed. The entire capital of £600,000 in £10 shares has been taken up and paid for in full. Mortgages and charges: £500,000.

ELECTRICITY SUPPLY ACCOUNTS.

Burnley Municipal Electricity Supply.

An inspection of the Burnley report for the past year discloses an exceptionally happy state of affairs. Aided no doubt by recent tramway completions, the output has increased by some 35 per cent., the revenue benefiting proportionally. With total working costs at 1d. per unit (inclusive of sundry special charges) and financial charges descending on the average, the department earned a balance of over £5,000 as compared with some £3,500 in the previous year. A satisfactory feature is the rising load factor, now 16, which, if the department can see its way to giving greater encouragement to the use of the motor—by adopting more reasonable rates, should show still further improvement.

The prices charged are:—Private lighting, 4d.; power, 3d., 2d., and 1d.; and traction, 1⅞d. per unit. The chief engineer is Mr. Robert Birkett.

General Statement.

For year ending March 31st—	1904.	1903.
Total capital expended	£85,604	£75,147
Number of units sold—		
Private supply	477,699	391,692
Public lighting...	9,762	10,552
Traction	1,252,338	891,079
Total number of units sold ...	1,739,799	1,293,323
Equivalent No. of 8-c.p. lamps connected	37,333	31,995
H.P. of motors connected	181	100
Number of public lamps	—	—
Maximum load in kw.	1,247	947
Revenue account—		
Gross revenue	£16,838	£13,456
„ expenditure	£7,399	£5,680
„ profit	£9,439	£7,776
Average price obtained per unit—		
Private lighting	3·99d.	4·00d.
Power	2·12d.	2·78d.
Public lighting	3·00d.	3·00d.
Traction	1·75d.	1·87d.

Revenue Account for Year ending March 31st, 1904.

Gross revenue	£16,838 =	2·32d. per unit.
Works and distribution costs (including public lighting)	£5,544 =	·76d. „
Total working costs	£7,399 =	1·02d. „

Profit Statement.

Interest on loans	£2,109
Sinking fund	2,206
Balance on year's working	5,124
Gross profit	£9,439

Glasgow Municipal Electricity Supply.

We give herewith the returns of the Glasgow electric lighting undertaking for the past year. That it has been successful may be judged from the fact that, in addition to meeting working and financial charges, provision for depreciation (some £32,000) was made, and the debt to the Gas Department, some £14,000 (incurred in the previous year under special circumstances), which had been paid since then, was largely covered by the remaining balance, the sum of £3,554 remaining as a deficit, carried forward to next year.

We quote portions of the committee's report in regard to the special features of the year's working:—

There was an increase of revenue from all sources of £31,185, while the working expenditure had only increased £10,599. The cost of generation and distribution shows a decrease in proportion, to the quantity of electricity generated. The result of the year's ordinary working was a balance of £45,222, as compared with £30,819 last year.

The capital expenditure during the year amounts to £109,482 12s. 11d., making the total capital expenditure as at May 31st, 1904, after deduction of the depreciation noted above, £1,119,047 14s.

Subject to a slight modification of the power rate conditions, the committee recommend that the charges for energy should remain the same as last year.

The number of consumers at May 31st, 1904, was 9,324, as compared with 7,013 at May 31st, 1903, being an increase of 2,311, or 32·95 per cent. during the year. The total number of motors in use and supplied off the Corporation mains as at May 31st, 1904, was 1,453, with a total horse-power of 6,501, as compared with 1,059, with a total horse-power of 4,597 as at May 31st, 1903. The number of units consumed for power purposes was 2,873,941. The total number of arc lamps in use in the streets was 814, as compared with 719 at the same date last year, and the quantity of electricity consumed for street and stair lighting was 1,503,546 units as compared with 1,081,836 units during the preceding year. The number of 8-c.p. lamps, or the equivalent in other devices applied for, and recorded in the books of the department as being connected to the mains at May 31st, 1904, was 805,058, as compared with 630,708 at the corresponding date last year, being an increase of 174,350. The maximum load also showed an increase of 23 63 per cent.

Contracts have been entered into for the completion of the northern end of the generating station at Port Dundas, including a second chimney, the necessary boiler-house, engine-house, and high tension switch-room. The building operations are now well advanced, and there is every reason to suppose that they will be ready for occupation during the coming winter. Contracts have also been entered into for the supply of four new boilers and of two large steam turbines, together with three-phase high tension alternators, and for all the switchboards and controlling accessories in connection therewith. Condensing plant for the steam turbines and the necessary steam and other accessories in connection with this plant have also been ordered and are to be, in part, ready for assisting in the supply required for the coming winter. At Pollokshaws Road station the 750 H.P. engine with two dynamos, has been completed. A new boiler has been added during the year and three more boilers have been ordered, together with a steam turbine, with two continuous current dynamos and condensing plant, and three cooling towers for cooling the condensing water. These are also intended for operation during the coming winter. The old Waterloo Street station has been converted entirely into a sub-station, and the three high tension motors coupled to six of the original dynamos, were in successful operation during the dark months of last winter. Contracts have been entered into for the supply of further motor-generators for this sub-station, which can be used either in connection with the supply from Pinkston or with the new high tension supply now being arranged for at Port Dundas station. A new sub-station has been arranged for on part of the site of the Dalmarnock Gas Works, and will shortly be erected. Motor-generators have also been ordered for this sub-station. The high tension supply for the Dalmarnock sub-station will be meantime taken from the Whitevale sub-station of the Tramways Department.

The arrangement between the Tramways Department and the Electricity Department worked satisfactorily through the past winter, and has been renewed for the coming winter. The amount of energy taken from the Tramways Department during the past winter was 700,372 units, and it is expected a like amount will be taken during the coming winter.

The Kelvinside station remains as it was last year.

The horse-power of steam plant available in the works belonging to the Electricity Department was—

Port Dundas station	12,100 H.P.
Pollokshaws Road	5,150 „
Kelvinside	1,080 „
Total	18,330 „

The horse-power provided by the Tramways Department during the winter months was from 2,000 H.P. to 4,000 H.P.

About six miles of feeder have been laid during the year on the north side of the river, and about one mile on the south side of the river, exclusive of 140 yards of feeder laid in Kinning Park, while about sixteen miles of distributing main have been laid on the north side of the river, and eleven miles on the south side, exclusive of 675 yards of distributing main laid in Kinning Park.

The prices charged are:—Private lighting: (1) Shops, offices, &c., maximum demand, 6d. per B.T.U. first hour, and 1d. (250 volts), 1½d. (200 volts), or 2d. (100 volts) afterwards per unit; domestic consumers and theatres, 3½d., and churches 3d. per unit respectively, flat rates; power, 1½d. to ⅔d. per unit; public lighting, £14 and £12 per annum for 10 and 7½-amp. lamps respectively; stair lighting, 25s. to 37s. 6d. per lamp per annum, according to size. The chief engineer is Mr. W. A. Chamen.

General Statement.

For year ending May 31st—	1904.	1903.
Total capital expended	£1,119,048	£1,041,746
Number of units sold—		
Private supply	13,604,119	10,419,488
Public lighting	1,460,780	1,064,404
Contract	42,766	17,432
Total number of units sold ...	15,107,665	11,501,324
Equivalent No. of 8-C.P. lamps connected...	805,058	630,708
H.P. of motors connected	6,501	4,597
Number of public lamps	814	719
Maximum load in KW.	25,762	20,183
Revenue account—		
Gross revenue	£158,190	£127,004
„ expenditure	£64,439	£58,668
„ profit	£93,751	£68,336
Average inclusive price obtained per unit—		
Sale of energy per meter	2·59d.	2·74d.
Public lighting	1·86d.	1·84d.

Revenue Account.

	1904. Gross.	1904. Per unit.	1903. Gross.	1903. Per unit.
Gross revenue... ...	£158,190	2·59d.	£127,004	2·74d.

Works Costs, &c.

	1904. Gross.	1904. Per unit.	1903. Per unit.
Coal, &c.	£14,085	·22d.	·27d.
Energy purchased from tramways department	4,595	·07d.	·02d.
Oil, waste, water and engine room stores	2,421	·04d.	·04d.
Wages incurred in generation and distribution...	8,094	·13d.	·16d.
Repairs and maintenance of plant, cables, &c.	12,164	·19d.	·26d.
Works and distribution costs ...	£41,359	·65d.	·75d.
Attendance and repairs, public lamps	3,112	·05d.	·06d.
Rent, rates and taxes	9,452	·15d.	·13d.
Management expenses, including salaries of engineer and clerical staff	4,470	·07d.	·08d.
General establishment charges, printing, stationery and advertising ...	3,346	·06d.	·05d.
Special charges incurred in change of voltage, Parliamentary expenses, &c.	2,700	04d.	·17d.
Total works costs	£64,439	1·03d.	1·24d.

Profit Statement.

	1904.	1903.
Interest on loans	£36,023	£33,275
Sinking fund	15,206	11,771
Deficit on year's working...	−3,554	−13,895
„ „ „ repaid... ...	13,895	—
Depreciation on works and machinery ...	32,181	37,186
Gross profit	£93,751	£68,337

STOCKS AND SHARES.

Wednesday Evening.

Little that is fresh has occurred extraneously to affect the markets, and prices are therefore largely dependent upon their own merits for the current fluctuations. Money is plentiful enough for the purposes of short loans, and the Stock Exchange settlement this week has been financed very easily. Business continues to broaden out here and there, but the widening of the circles of public interest is still a matter painfully slow to the Stock Exchange member who looked for a substantial increase in trade during September. Electrical issues mostly maintain their strength; in the Supply section there are a number of gains to record, and only a single decline.

Fair activity characterises the Railway department. City and South London Ordinary has advanced a further 2 per cent. to 45 bid, and it is by no means easy to obtain a dealing price in even a few thousands of the stock. Judging from the contangoes that were arranged last Tuesday, the market is short of stock. The three Preferences stand at 122½, 118½ and 116½ for the 1891, 1896 and 1901 stocks respectively. Central London Deferred has shed a point at 80. Assuming a continuance of the 4 per cent. dividend, this would give the buyer a return of the round 5 per cent. on his money. But the Ordinary may conceivably turn out to be the cheaper stock to buy, although it is 7 points higher in value. There has been a small demand for Great Northern and City Preferred "A" shares, upon tardy recognition of the advantages the company is securing by virtue of its agreement with the Great Northern Railway. The price has risen to 5¼ middle, which, by the way, represents about half the equivalent quotation at which Great Northern 4 per cent. Preferred stock is now standing. Metropolitan Consolidated at 94 has fallen 1 per cent., and the Surplus Lands stock is also duller at 73. Districts at 38½ show a decline of the fraction. A few orders in East London Consolidated serve as a reminder that the price is about 4½. As there is only 3¼ millions of the stock created and issued, it would be an easy matter for the price to be "put along," as the Stock Exchange phrases it, if a strong clique took it in hand.

Tramway securities are steady, with a strong tone developing in Argentine descriptions. Barcelona are harder at 9⅜; why the *Stock Exchange List* should send the price out so absurdly wide as 9—10, it is impossible to say. Rather better, too, are Calcutta Trams at 7⅞; and Buenos Ayres and Belgrano firmed up when the interim dividend was declared. The Ordinary shares are 3¼, the "A" and "B" Preferred 5½ and 5¼ respectively, while the two Debentures are quoted 106½ and 103½, the latter, of course, being the Second Debenture stock. This dividend announcement came as an agreeable surprise to the market. Potteries Debenture was marked 102¼ and 103¼ on Tuesday, and we should imagine that neither buyer nor seller was particularly pleased with his price. A sixpenny fall has taken Metropolitan Electric Trams Deferred to 4s. 6d.; the Preference are 18s. 6d., and the Debenture stock maintains its price at 88. There are no changes to report in the British Westinghouse descriptions, and Thomson-Houston Debenture keeps at par. British Electric Traction Ordinary at 9¼ has risen 5s., and a similar rise in City of Buenos Ayres Trams makes the price 10½. The advance is based upon the possible value of the new Preference shares that will supersede the present City of Buenos Ayres Ordinary next January. Anglo-Argentine Ordinary are ⅛ better at 6⅜, upon a continuance of the good traffics.

Profit-taking has reduced the prices of the Anglo-American Telegraph group. After being decidedly better, they are concluding the week, since last Wednesday, with a point fall in the Preferred and Ordinary, with ¼ fall in the Deferred stock. This last now stands at 8¼. Eastern issues fail to move, but Great Northern Telegraphs rose as much as £2, to 28, upon the probable prolongation of the war. The market is also very short of the shares. Globe Preference came on offer the other day, and the price lost ¼ at 13⅜. With these few changes, the tale of Telegraph movement is recited. National Telephone stocks are still on the upward plane, and a fresh rise of a point brings the Deferred Stock to 93½. The Preferred is a good market at 105½.

Regarding Electricity Supply shares, County Ordinary rose ½ to 8½, and a rise of ¼ stands to the credit of South London Ordinary at 4¼. Notting Hills at 15 are also 10s. to the good, and South Metropolitan Preference at 1⅜ are 2s. 6d. better. Central Electric 4 per cent. Debenture added a point at 103½, which would appear to make the stock valued at its full worth, and several other Debentures are slightly better on balance. With the approach of winter there is usually a tendency amongst investors to buy lighting shares, and the present improvement shows that the regular autumn annual is not dead by any means. Even where no quotable change has occurred this week, it is increasingly difficult to buy at prices anywhere near the middle of the irritatingly wide margins officially given by the Stock Exchange. Westminsters came on offer on Wednesday, causing the price to drop 10s. to 12½, but Charing Cross Preference improved ⅛ to 5⅜, Calcutta Electric ¼ to 7⅜, while the narrower quotation of 16—16½ for Metropolitan Ordinary more accurately represents the strength of these shares. At 2, London Electrics mark a 5s. advance, and this section, as already indicated, is attracting increased attention from investors.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Sept. 7th.	Closing Quotations Sept. 14th	Business done week ended Sept. 14th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	97 —101	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½— 3½	2½— 3½	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	51 — 54	50 — 53	51½	..
8,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	96 — 98	95 — 97	97	95
8,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	8½— 8¾	8 — 8½	8⅝	8 3/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5 — 5½	5 — 6½	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	94 — 96	94 — 96	94½	..
16,000	Cuba Telegraph	10	4 %	6¼%	5 %	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
6,000	Direct Spanish Telegraph	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101 %	98 —101%	..	..
60,710£	Direct United States Cable	20	8½%	8½%	8 %	10 — 10½	10 — 10½	10⅛	..
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	126 —131	126 —131	131	129½
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	89½	88⅝
1,584,845	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	105 —108	..	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12⅝	12⅛
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	103 —106	103 —106	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103	100 —103 %	102¼	..
180,227	Globe Telegraph and Trust	10	6½%	£3 16 7*	5¾%	8⅞— 9¼	8⅞— 9¼	9⅛	9
180,042	Do. do. 6 % Pref.	10	..	..	..	13½— 14½	13½— 14	13 13/16	..
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	25½— 26½	27½— 28½	..	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	43 — 46	43 — 46	..	..
72,680	Monte Video Telephone Co., Ltd., Ord.	1	..	..	..	— —	7/16— 9/16	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —106	104 —106	106	105
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	91 — 94	92 — 95	95⅜	92½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 5/16	5 5/16
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	97½	..
689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104 —106	104 —106	105½	..
1,000,000	Do. do. Prov. Certs., 85 % to be paid	..	..	..	..	65 — 68	66 — 68	67½	..
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6¼%	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	100	..
11,889	Reuter's	8	5 %	5 %	..	6¾— 7¼	6¾— 7¼	..	..
3,308	Submarine Cables Trust	Cert.	..	..	..	118 —123	118 —123	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6¼	6 — 6¼	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4½— 5½	4½— 5½	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,609	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	.. — ..	7/16— 9/16	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	..	..	..	97 — 100	97 —100	..	..
267,930	Western Telegraph, Ltd., Nos. 1 to 207,930	10	7 %	7 %	7 %	12 — 12½	12 — 12½	12⅛	..
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	100 —103	100 —103	..	..
88,821	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
34,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6¼— 6½	6¼— 6½	6 11/16	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
60,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	100 —103	100 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	..	..
800,000£	Do. do. 5% 1st Mort. Deb. Stock Red.	Stock	..	..	..	92 — 97	92 — 97	..	..
100,000	British Electric Traction	10	9 %	8 %	..	8¾— 9¼	9 — 9½	9¼	9
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10½— 11	10½— 11	10 13/16	10 11/16
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	117 —120	117 —120	118⅛	118⅜
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	94 — 97	94 — 97	95⅛	95⅛
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5¾— 6¼	5¾— 6¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾— 6	5½— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	7/16— 9/16	7/16— 9/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	½— ¾	½— ¾	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1 — 1½	1 — 1½	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	94 — 97 xd	94 — 97	..	..
*25,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	70 — 75	70 — 75	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½— 10½	9¼— 10½	9½	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	101 —105	101 —105	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	86 — 88	86 — 88	87⅛	86
494,998	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	100 —102	100 —102	102	101
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	80 — 82	79 — 81	80⅜	80½
1,890,000	City and South London Railway	Stock	2 %	3½%	2¾%	42 — 44	41 — 46	45⅛	44
85,000	Crompton & Co., Nos. 1 to 85,000	5	7½%	5 %	..	1½ — 2	1½ — 2	1⅝	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	90 — 95	90 — 95	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £8 paid, 1 to 99,261	5	Nil	Nil	..	½— ¾	½— ¾	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 83	79 — 83	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1 — 1½	1 — 1½	..	..
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	2	..	..	..	2 — 2½	2 — 2½	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9½	9 — 9½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	11 — 12	10½— 11½	11¼	10⅞
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5¼xd	5 — 5¼	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111 xd	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18½— 19½	18½— 19½	19 3/16	18⅞
900,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	12½%	12½%	..	9½— 9⅝	9⅜— 9⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
97,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	34 — 37	34 — 37	35½	..
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3½%	3½%	86 — 89	86 — 89	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Sept. 7th.	Closing Quotations Sept. 14th.	Business done week ended Sept. 14th, 1904. Highest.	Lowest
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	‡	8⅝	8 %	10 %	10⅜— 11½	10⅜— 11½	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10¼— 10⅝	10¼— 10⅝	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	106 —109	107 —110	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7⅜— 8½	7⅜— 8½	..	..
70,000	Do. do. 4½% Cum. Pref. ..	5	..	..	..	5¼— 5⅝	5¼— 5⅝	5 5/16	5 3/16
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4¼— 5	4¼— 5	4 15/16	4 13/16
40,000	Do. do. 1908	5	..	..	..	4¼— 5	4¼— 5	4 15/16	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	..	..
44,486	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5½%	6¾— 7	6¾— 7	..	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	5 %	5 %	5 %	10¼— 10⅜	10¼— 10⅜	10 5/16	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	120 —125	120 —125	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	104½	104
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	7⅜— 8½	8 — 9	8¼	8 3/16
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11½ — 12	11½ — 12	..	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	105 —108	105 —108	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —104	101 —104	..	..
50,000	Edmundson's Electricity Corporation, Ord. Shares	5	7 %	7 %	7 %	6 — 6¼	6 — 6¼	6 3/32	6 1/16
80,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6¼	6 — 6¼	6¼	6⅛
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	104 —107	105 —108	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12½	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1¾— 2	1¾— 2¼	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5 — 5⅛ xd	5 — 5⅛	..	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6¾%	7¼%	8¼%	15¼— 16¼	16 — 16¼	16⅛	16 1/16
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5⅜— 5⅝	5⅜— 5⅝	5⅜	5 5/16
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	110 —115	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	14 — 15	14½— 15½	14⅝	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½— 15½	14½— 15½	14⅝	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	2¼— 2½	2¼— 2½	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 88	83 — 88	..	..
65,000	South London Electricity Supply, Ord.	5	..	1¾%	3 %	3¼— 4¼	4 — 4⅛	4¼	4⅛
100,000	South Metropolitan Electric Light and Power, Ord.	1	..	..	..	¾— 1	¾— 1	¹³/₁₆	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛— 1⅜	1⅛— 1⅜	1⅜	..
100,000	Do. 4½% 1st Deb. Stock	100	..	..	..	105 —109	105 —109	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4¼— 5¼	4¼— 5¼	4 31/32	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4¼— 5¼	4¼— 5¼	5 1/16	4 31/32
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12¼— 13¼	12 — 13	12⅝	12⅝
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6¼	6 — 6¼	..	..

*Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, September 14th.

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.		5/-	..
a ,, Nitric .. .. per cwt.		22/-	..
a ,, Oxalic .. .. per cwt.		32/-	..
a ,, Sulphuric .. .. .. per cwt.		5/6	..
a Ammoniac, Sal .. .. .. per cwt.		42/-	..
a Ammonia, Muriate (crystal) .. per ton		£33 10	..
a ,, ,, ... per ton		£30	..
a Bleaching powder .. .. .. per ton		£4 10	..
a Bisulphide of Carbon .. .. per ton		£15	..
a Borax .. .. per ton		£18	..
a Benzole (90 %) .. .. .. per gal.		7/-	..
a ,, (50/90 %) .. .. .. per gal.		5/6	..
a Copper Sulphate .. .. .. per ton		£19	..
a Lead, Nitrate .. .. .. per ton		£30	..
a ,, White Sugar .. .. .. per ton		£31	..
a ,, Peroxide .. .. .. per ton		£27 10	..
a Methylated Spirit .. .. .. per gal.		2/6	..
a Naphtha, Solvent (90% a 160° C). per gal.		5/6	..
a Potash, Bichromate, in casks .. per lb.		8d.	..
a ,, Caustic (75/80%) .. .. per ton		£24	..
a Shellac .. .. per cwt.		210/-	..
a Sulphate of Magnesia .. .. per ton		£4 10	..
a Sulphur, Sublimed Flowers .. per ton		£6 10	..
a ,, Recovered .. .. per ton		£5 10	..
a ,, Lump .. .. .. per ton		£5	..
a Soda, Caustic (white 70 %) .. per ton		£10 15	..
a ,, Crystals .. .. .. per ton		£3	..
a ,, Bichromate, casks .. .. per lb.		2½d.	..

METALS, &c.

b Aluminium Ingots, in ton lots .. per ton		£130	..
b ,, Wire, in ton lots .. per ton		£168	..
b ,, Sheet, in ton lots .. per ton		£166	..
b Babbitt's metal ingots .. .. per ton		£48 to £180	..
c Brass (rolled metal 2" to 12") basis per lb.		6¾d.	..
c ,, Tube (brazed) .. .. per lb.		8¼d.	..
c ,, ,, (solid drawn) .. per lb.		7¼d.	..
c ,, Wire, basis .. .. .. per lb.		6¾d.	..
c Copper Tubes (brazed) .. .. per lb.		9¼d.	..
c ,, ,, (solid drawn) .. per lb.		9¼d.	..
c Copper Bars (best selected .. per ton		£70	..

METALS, &c. (continued).

		Latest Price.	Week's Dec. or Inc.
g Copper Sheet .. .. .. per ton		£70	..
g ,, Rod .. .. .. per ton		£70	..
e ,, (Electrolytic) Bars .. per ton		£62	..
e ,, ,, Sheets .. per ton		£78	..
e ,, ,, Rod .. per ton		£72	..
e ,, ,, H.C. Wire per lb.		7¾d.	..
f Ebonite Rod .. .. .. per lb.		3/8	..
f ,, Sheet .. .. .. per lb.		8/-	..
m German Silver Wire .. .. per lb.		1/6	..
h Gutta-percha fine .. .. per lb.		8/-	..
h India-rubber, Para fine .. .. per lb.		4/8 to 4/9	3d. dec.
i Iron, Charcoal Sheets .. .. per ton		£18	..
i ,, Pig (Cleveland warrants) per ton		43/-	3d. dec.
i ,, Forgings, according to size per ton		From £11	..
i ,, Scrap, heavy .. .. per ton		47/6 to 50/-	..
i ,, Wire, galvanised No. 8 .. per ton		£9 15	..
g Lead, English Ingot .. .. per ton		£12 2 6 to £12 5	2/6 to 5/- dec.
g ,, ,, Sheet .. .. per ton		£11 17s. 6d.	..
m Manganin Wire No. 28 .. .. per lb.		8/-	..
g Mercury .. .. per bot.		£7 15	..
d Mica (in original cases) small .. per lb.		6d. to 1/	..
d ,, ,, ,, medium per lb.		2/6 to 4/-	..
d ,, ,, ,, large .. per lb.		4/6 to 8/6	..
p Phosphor Bronze, plain castings per lb.		1/- to 1/2½	..
p ,, rolled bars & rods per lb.		1/- to 1/8	..
p ,, ,, strip & sheet per lb.		From 1/1	..
o Platinum .. .. per oz.		£4	..
e Silicium Bronze Wire .. .. per lb.		9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n per ton		£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block .. .. per ton		£127 10 to £128 10	..
g ,, Foil .. .. per lb.		1/6	..
n ,, Wire, Nos. 1 to 16 .. .. per lb.		1/6½	..
p White Anti-friction Metals—"White Ant" brand .. per ton		£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls per lb.		8d.	..
j ,, 6 lea. Flax .. .. .. per lb.		5¾d.	..
j ,, 3 ply 10 lbs. Russian .. per lb.		4¼d.	..
j ,, 10 lbs. Russian, single .. per lb.		4¼d.	..
j ,, 180 lbs. Jute rove .. per ton		£11	..
k Zinc, Sh't (Vieille Montagne bnd.) per ton		£25 5	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co., *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Aberdeen	Sep. 10	1,458	+203	15	24,671	+ 4,659	10	—
Bath	,, 10	839	—	37	23,075	—	12½	—
Birmingham ..	,, 10	5,231	+ 91	37	198,495	+11,473	3½	—
Blackburn	,, 2	1,026	+238	22	22,587	+ 2,336	13½	—
Blackpool	,, 8	2,011	+ 330	22	32,904	+ 4,430	8½	—
,, —Fleetw'd	,, 10	1,188	+ 48	10	15,235	+ 8	7½	—
,, —Lytham	,, 8	730	+ 141	45	17,477	+ 6,995	7½	—
Bolton	,, 11	1,918	+ 91	24	45,563	+ 362	25	—
Bournemouth ..	,, 7	1,461	+ 70	23	28,028	—	10½	—
Bradford	,, 10	4,904	+883	23	111,344	+19,854	50	—
Brighton	,, 11	1,218	+207	—	26,400	—	9	—
Bristol	,, 9	5,295	+155	—	—	—	28	—
Devonport ..	,, 2	631	+140	35	18,941	+ 3,178	5	—
Dudley—Sto'rb'ge	,, 2	1,016	+ 75	35	30,772	+ 1,229	16½	—
Gateshead ..	,, 2	954	+ 65	35	31,817	+ 1,414	10½	+ ½
Gr'n'k—Pt. Glsgw	,, 2	713	+ 68	35	20,270	+ 1,006	7½	—
Oldham—Ashton	,, 2	668	+ 45	35	19,424	— 845	8	—
Potteries	,, 2	1,774	+104	35	59,648	+ 5,041	28½	—
South Staffs. ..	,, 2	759	—307	35	27,069	— 4,235	21½	—½
Swansea	,, 2	631	+ 14	35	19,470	+ 1,025	5½	—
Wolverhampton ..	,, 2	428	+ 86	35	18,820	— 55	10½	+8
Yorks. Wool Dist.	,, 2	737	+215	35	21,169	+ 8,377	6	—
Miscellaneous ..	,, 2	4,865	—	35	128,582	—	—	—
Burnley	,, 10	1,137	+181	—	—	—	10½	+2½
Burton-on-Trent ..	,, 11	372	— 54	23½	8,795	—	6½	—
Cardiff	Aug. 20	2,189	+101	20	43,465	+ 1,376	14	—
Chatham & District	Sep. 8	652	— 5	36	21,451	+ 2,152	9·58	—
Cork	,, 8	509	—144	36	16,962	— 2,267	9·89	—
Dover	,, 10	272	+ 2	36	8,084	— 246	3	—
Dublin	Sep. 9	5,078	— 51	—	57,119	— 3,349	47	+ ½
East Ham	,, 10	748	+ 38	23	18,188	+ 1,409	6½	—
Glasgow	,, 10	14,871	+741	16	210,640	+13,250	71½	+ 5½
Halifax (2 weeks) ..	,, 7	3,357	+573	23	37,012	+ 3,034	33	+ 1½
Huddersfield ..	,, 10	1,536	+ 97	23	32,589	+ 2,633	28	—
Hull	,, 10	2,200	+286	23	50,927	+ 6,938	13	+ 2½
Ilkeston	,, 7	148	— 35	23	3,497	—	3·5	—
Ipswich	,, 10	605	—	23	12,759	—	10½	—
Isle of Thanet ..	,, 10	1,539	+248	36	28,131	+ 1,382	10½	—
Leeds	,, 10	6,242	+583	—	143,879	+ 9,400	81½	+ 2
Liverpool	,, 3	10,949	+524	36	372,818	+12,307	103	—
London C. C. ..	,, 3	13,709	+2977	23	284,181	+58,026	46½	+ 6½
Manchester	,, 3	12,987	+1097	22	276,784	+11,474	127½	+ 12½
Newcastle	,, 10	3,591	+ 79	—	—	—	17	—
Portsmouth	Aug. 27	2,673	+200	—	47,053	+ 4,188	14½	—
Salford	Sep. 5	4,158	+110	22	94,231	+ 6,879	30	—
Sheffield	,, 4	4,810	+107	23	110,005	+ 2,675	33	+ 6½
Southampton ..	,, 8	1,317	+112	—	—	—	9	—
Southend-on-Sea ..	,, 7	518	+ 6	23	10,010	+ 1,123	6½	—
Sunderland	,, 11	1,392	+200	24	31,674	+ 926	21	+ 1
Tynemouth	,, 7	455	+ 46	36	14,019	+ 2,184	8·9	+ ·4
West Ham	,, 8	1,183	—	28	25,003	—	8·62	—
Wolverhampton ..	,, 7	778	+318	—	—	—	9·5	—
Cen. London Rly. ..	,, 10	5,880	+343	10	58,062	— 1,614	6	—
City & S. Lon. Rly.	,, 11	2,555	— 77	11	25,760	— 1,145	6½	—
Dublin—Lucan Rly.	,, 9	127	— 38	10	1,485	— 15	6½	—
G. N. and City Ry.	,, 10	1,069	—	80	28,437	—	3½	—
L'pool Overh'd Rly.	,, 11	1,521	—151	11	18,484	— 422	6½	+ ½
Mersey Railway ..	,, 10	1,416	+123	10	14,338	+ 909	4½	—

* Compared with the corresponding period of 1903.

THE DESIGN OF DYNAMOS.

By A. PRESS.

THE design of dynamos may be resolved into two steps, the one the determination of the gross dimensions of the armature core, and the other the determination of the slot dimensions and the corresponding working magnetic density. The output and speed are usually given, and the gross dimensions are obtained from the output equation with a consideration as to the best number of poles to employ. The *rationale* of the output equation was pointed out in a communication to the *Electrician* for March 25th, 1904, but the main development may be indicated here :—

Let η = efficiency.

τ = final temperature rise.

D = diameter of armature.

L = length axially of the end connections.

l = length of core.

W = output in watts.

ν = radiating constant for temperature rise τ_0.

$100\,f$ = factor giving loss radiated by armature when multiplied by the total losses of machine.

Then—

$\frac{W\,(100 - \eta)}{100}$ = loss in watts of apparatus.

$W f (100 - \eta)$ = armature watts dissipated, but from experience,

$\frac{\text{Watts}}{\text{surface} \times \text{revs.}} = \frac{\nu\,\tau}{\tau_0}$ and watts radiated by the armature is given by—

$$W f (100 - \eta) = \pi\,D \text{ revs.} \times \pi\,D\,(L + l) \times \frac{\nu\,\tau}{\tau_0}$$

and

$$W = \frac{\pi^2\,\nu\,\tau}{\tau_0 f (100 - \eta)}\,D^2\,(L + l) \text{ revs.} \qquad (1)$$

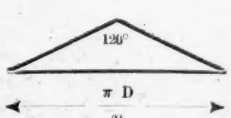
This is the most general form of output equation. It is usual for constructional reasons to take the length of the core as proportional to the pole pitch. Usually the aim is a square pole-shoe, so as to obtain the minimum condition of round poles; but the end connections are found in practice to be also proportional to the pole pitch, since the angle subtended by the ends is in the neighbourhood of 120° for all cases, this latter condition thus permitting of a minimum copper loss for a ratio of D to l in terms of p that practically coincides with the condition of square pole shoes. Taking the $D^2\,l = K$ or a constant, the length of mean turn of the armature coils is given by $2\,l + \frac{c\,\pi\,D}{p}$, and

hence $$\frac{d}{d\,D}\left(2\,l + \frac{c\,\pi\,D}{p}\right) = \frac{d}{d\,D}\left(\frac{2\,K}{D^2} + \frac{c\,\pi\,D}{p}\right),$$

or— $$\frac{c\,\pi}{p} = \frac{4\,K}{D^3} \text{ and } \frac{D}{l} = \frac{4}{c\,\pi}\,p.$$

The value of c can be obtained by solving the triangle where the angle opposite the pole-pitch length or span is 120° and the pole-pitch is $\frac{\pi\,D}{p}$.

The value of c becomes $\frac{4}{\sqrt{3}}$.



Hence $$\frac{D}{l} = \frac{\sqrt{3}}{\pi}\,p = \cdot 55\,p. \qquad (2)$$

Taking an effective pole-pitch multiplier of ·7, the length of the core becomes $= \frac{\cdot 7\,\pi\,D}{p}$, and hence

$$\frac{D}{l} = \frac{p}{\cdot 7\,\pi} = \cdot 455\,p, \qquad (3)$$

which is very nearly the value given by Equation (2). If the equation expressing the ratio of $\frac{D}{l}$ be taken as—

$$\frac{D}{l} = \varepsilon\,p,$$

where the value ε = about ·5, the equation for output (1) becomes by reduction—

$$W = \frac{\pi^2\,\nu\,\tau\left(1 + \frac{\pi\,\varepsilon}{\sqrt{3}}\right)}{\tau_0 f (100 - \eta)} \cdot D^2\,l \text{ . revs.} \qquad (4)$$

The "design coefficient"—

$$s = \frac{\pi^2\,\nu\,\tau\left(1 + \frac{\pi\,\varepsilon}{\sqrt{3}}\right)}{\tau_0 f (100 - \eta)},$$

and is thus seen to be a very slowly varying quantity.

Obviously, if the value of p is assumed as known, the particular dimensions of the carcase immediately follow. An empirical formula that will serve as a guide to the proper determination of p is the following :—

$$2^{\frac{p-4}{2}} = \frac{D^2\,l\,(\text{cm.}^3)}{150{,}000}. \qquad (5)$$

The price of the machine will, however, decide in most cases the exact number of poles to be used, though the sparking qualities as well as the efficiency must be separately determined. It is as well to notice that the formula for price—

$$\text{Cost} = a\,D^x\,l^y$$

(where x must be greater than 2 y if larger diameters cost more relatively than small ones) can be reduced to the form—

$$\text{Cost} = a\,(\varepsilon\,p)^{\frac{x-2y}{3}}\left(\frac{W}{s\,R}\right)^{\frac{x+y}{3}}$$

which shows that a large design coefficient s means a cheaper construction.

There is then the shape of the slots, and the proper magnetic density in the iron to be decided upon. Let the following independent variables be taken :—

n = number of slots.

D = diameter of armature.

$r = \frac{\text{tooth width}}{\text{tooth pitch}}$.

ρ = ratio of depth to width of slot.

The dependent variables may be the following :—

$$Z = \frac{\pi\,D}{n} = \text{tooth pitch.}$$

$$\lambda = \frac{\pi\,D\,\rho\,(1 - r)}{n} = \text{slot depth.}$$

The excitation loss in the air gap and teeth is dependent upon the above variables. A minimum excitation loss condition can be determined with regard to the independent variable r.

The teeth ampere-turns per pole are—

$$\frac{10}{4\,\pi}\,H\,\lambda = \frac{10}{4\,\pi} \cdot H \cdot \frac{\pi\,D\,\rho\,(1 - r)}{n},$$

and the teeth ampere-turn loss in watts can be expressed as :

Teeth excitation watts—

$$= \mu\,\frac{10}{4\,\pi}\,D\,\rho\,H\,(1 - r),$$

where μ depends upon the L.M.T. of the field coils, and the current density employed. The air gap ampere-turns per pole $$= \frac{10}{4\,\pi}\,\{B\,r + H\,(1 - r)\}\,\delta\,K_1$$

where B is the real density in the teeth, δ is the air gap length, and K_1 is Prof. Arnold's multiplier, which from the tabulated data given in his book "Die Gleichstrommaschine," can be expressed as follows :—

$$K_1 = \frac{1}{r + \sqrt{\frac{\delta}{Z}}\,(1 - r)}.$$

The combined excitation loss is—

$$= \mu\, a^1\, \mathrm{H}\,(1 - r) + \mu\, \mathrm{K}_1\, b^1\, \{\mathrm{B}\, r + \mathrm{H}\,(1 - r)\}$$

and $$\frac{d}{d\,r} = 0 = -\mu\, a^1\, \mathrm{H} + \mu\, \mathrm{K}_1\, b^1\, \mathrm{B} - \mu\, b^1\, \mathrm{K}\, \mathrm{H} + \mu\, b^1\, \{\mathrm{B}\, r + \mathrm{H}\,(1 - r)\}\, \frac{d\,\mathrm{K}_1}{d\,r},$$

whence it can be shown that—

$$\frac{\mathrm{B}}{\mathrm{H}} = \frac{1 + \frac{\pi\, \mathrm{D}\, \rho}{n\, \delta\, \mathrm{K}}}{1 - \mathrm{K}\, r\left(1 - \frac{1}{2\sqrt{\frac{z}{\delta}\,(1 - r)}}\right)} \quad (6)$$

If the influence of K as a function of r is neglected, that is, that $\frac{d\,\mathrm{K}}{d\,r} = 0$, the above value of $\frac{\mathrm{B}}{\mathrm{H}}$ simplifies to

$$\frac{\mathrm{B}}{\mathrm{H}} = \frac{\frac{\pi\, \mathrm{D}\, \rho}{n} + \mathrm{K}_1\, \delta}{\mathrm{K}_1\, \delta} = \frac{\frac{\pi\, \mathrm{D}}{n}}{\mathrm{K}_1\, \delta}\, \rho + 1$$

$$= \frac{\text{Tooth pitch} \times \text{slot depth}}{\text{effective air gap length} \times \text{slot width}} + 1. \quad (7)$$

This equation, as giving the value of $\frac{\mathrm{B}}{\mathrm{H}}$ to a first approximation, has a great deal of useful and *geometric* interest.* This last equation has been found to give very consistent results when checking over old design.

The slot dimensions would not, however, be sufficiently controlled with the "excitation condition" as to the value of r. The iron and copper losses must also be taken into account. The volume of the teeth is—

$$\text{Volume of teeth} = \pi\, \mathrm{D}\, r\, l\, \lambda\, i\, v,$$

where i is the iron factor and v is the ventilating factor, or

$$\text{Teeth volume} = \frac{\pi^2\, i\, v\, \mathrm{D}^2\, l\, \rho\, r}{n}\,(1 - r).$$

The losses in the teeth in watts may be expressed as—

$$\text{Teeth watts} = a\, r\,(1 - r) = \mathrm{P}.$$

The copper loss depends, first, upon the copper cross-section, or $\pi\, \mathrm{D}\,(1 - r) \times \lambda = \frac{\pi^2\, \mathrm{D}^2\, \rho\, (1 - r)^2}{n}$.

The flux of the field in calculating the copper loss can be taken as

$$\mathrm{B} \times \pi\, \mathrm{D}\, r \times l\, i\, v\, f_p,$$

where f_p is the pole-pitch factor.

The current volume is—

$$\frac{\mathrm{W}}{p\, \mathrm{E}} = \frac{60 \times 10^8.\ \mathrm{W}}{p\ \mathrm{R.\ F}};$$

substituting the value of B in the term F, the armature copper loss can be represented by—

$$\text{Copper loss} = \frac{\beta}{r^2\,(1 - r)^2} = \mathrm{Q},$$

in terms of the independent variable r. The total iron and copper losses are thus—

$$\text{Total loss} = a\, r\,(1 - r) + \frac{\beta}{r^2\,(1 - r)^2} = \mathrm{P} + \mathrm{Q}.$$

The value of a may be taken as including the armature core losses on the assumption that the total iron losses are proportional to the teeth iron losses—

$$\frac{d}{d\,r} = 0 = \frac{d}{d\,r}\left\{a\, r\,(1 - r) + \frac{\beta}{r^2\,(1 - r)^2}\right\}$$

$$a - 2\, a\, r = \frac{2\,\beta\,(1 - 2\,r)}{\{r\,(1 - r)\}^3}$$

$$a = \frac{2\,\beta}{\{r\,(1 - r)\}^3}$$

$$\mathrm{P} = 2\,\mathrm{Q}. \quad (8)$$

The total iron loss in teeth and core must then be equal to twice the armature copper loss, *so that for any value of* λ *given, that assumed value of* r *will be the best which makes the copper losses one-half the total iron loss.* This condition may not always be possible, but it is one that one should strive to attain. In very small machines the copper loss is very much greater than the iron loss, and in very large machines the iron loss is very much greater than the copper loss. The value of B with an assumed value of r, is obtained from the "excitation equation." An empirical formula for the value of λ is the following :—

$$\lambda = 2\, \log_{10} \mathrm{D}\ (\text{cm.}).$$

The values given by the above empirical formulæ should be purely tentative. The number of teeth per pole is usually from 7—12, and the value of ρ should never be more than 3. In determining the question of cost a formula of the form

$$\text{Price} = a\, p^{\frac{x - 2y}{3}}\, \mathrm{K}^{\frac{x + y}{3}}$$

should be consulted. The value of x here is about 1·5 and the value of y about ·5.

* In the case of induction motors and alternators with overhung slots, the condition $\frac{d\,\mathrm{K}}{d\,r} = 0$ can be said to prevail exactly. The overhang in the geometric representation of $\frac{\mathrm{B}}{\mathrm{H}}$, therefore, has no influence on the value of B that should be employed.

ELECTRICITY AT THE WASHINGTON NAVY YARD.

Writing in our New York namesake recently, Mr. J. E. Price gave some particulars of this work which is now in progress, and he termed it "the biggest job of its kind in the world." The work is the equipping of the gun lathes in the big gun shop with electric drives, and making other improvements with electric outfits, thus supplanting the wilderness of shafting, belting, wheels and other details of the steam driven machinery now used.

A new power plant is being built which will furnish power for all the workshops, excepting the model-making shop, which has a plant of its own, that also furnishes current for operating the towing carriage of the model-testing tank. The new power house will have a boiler capacity of 6,000 H.P. The engine equipment will consist of four 500-KW., 244-volt, direct current generators, running at 120 r.p.m., direct connected to vertical cross-compound engines. One of the improved features of the new power house will be its method of obtaining water. This will be brought over a distance of 600 ft. from the eastern branch of the Potomac river, by gravity through a 36-in. conduit which will lead to a well. The system will be economical, as it will do away with the necessity for suction pipes; and an abundance of water can be had at all times.

The electric plant now in use in the yard is quite sufficient for present work, but when the steam-operated machinery gives place to the electrically worked, the power afforded will not be sufficient. The plant consists of four engines with a combined output of 1,325 H.P., two of 300-H.P., cross-compound, Ball & Wood, running at 250 r.p.m.; one tandem-compound, 125 H.P., running at 300 r.p.m., and one McIntosh & Seymour of 600 H.P., running at 130 r.p.m. The smaller ones are direct connected to two generators on the Edison three-wire system. The boiler service is equal to about 2,500 H.P.

The present electric plant supplies light and power, the number of lights consisting of 6,000 incandescent and 450 arc lamps. There are 17 electrically-operated travelling cranes in the shops and 152 motors. The largest crane is of 110 tons capacity; the smallest, 10 tons. Some of the motors are mounted in the galleries and connected to shafting; others, especially in the shops where small fixings are finished, are mounted on or connected at the floor with machines.

Under direction of Mr. C. E. Reid, chief electrician of the navy yard, the work of installing the new apparatus for operating the big gun lathes is being carried on as fast as such a large undertaking could be expected. There are eight of these lathes distributed over the 1,000 ft. of length of the main gun-building shop, and each takes up about 50 ft. of the 80 ft. of width of the building. These lathes are ponderous and require for movement an aggregate of 850 H.P. By the new arrangement of a multi-

voltage system, each lathe will receive current for 56 H.P. The armature of the main driving motor will be mounted on a bronze sleeve which will run on the present cone shaft. A 10-H.P. motor will also be employed on each lathe for moving the tool carriages which hold the tools used in gun trimming and polishing.

When the gun shops get their full electrical equipment there will be only three shops in the Washington navy yard not completely fitted in this respect; but these now have electric cranes and some other electric features. All shafting will be done away with. The use of belting as still continued, in a number of the shops, has its marked disadvantages. It takes up room that could be otherwise employed; it is in this way causing delay in the movements of men and material; and a particularly objectionable feature of this method of drive is in the fact that when a main belt breaks the whole machine work of the shop must be stopped until repairs are made.

SIMPLE STORIES.

By "INNOCENS."

VIII.—B'RER RABBIT'S ENGINE.

NOTE.—The artistic appearance of a certain generating station is marred by three large masses of cast-iron which were attached to the pump levers of an engine in order to cure its tendency to vibrate. These have an imposing appearance when oscillating at 70 periods per minute, but the pathos of the situation lies in the fact that the vibrations are now, if anything, worse.

B'rer Rabbit, he reckon he start a lighting station, so he gets ebberything fixed up with B'rer B'ar to build de place and put in de foundations, c'ase B'rer B'ar, he berry strong.

B'rer B'ar, he calkilate dis job was where he was gwaine to advertise hisself, and he start in mighty keerful. De fust two foundations he make berry strong, with three-to-one concrete, an' no hurry, an' he stomp it down well.

B'rer Rabbit look on, an' he say, "Dat am a damfine job of youahs, B'rer B'ar. Come 'long o' me and make a suction-joint." So dey make moah dan one suction-joint, and B'rer B'ar, he come back feelin' kinder off the earth with pure cheerfulness.

Anyhow, B'rer B'ar, he not so keerful ober de third foundation, an' it was just a leetle crumbly, c'ase B'rer B'ar he saw too many sacks of cement when he mix de concrete, an' de mixture only came to six-to-one.

B'rer Rabbit, he not see dat, an' he gib B'rer B'ar de contract to put up de engines, which were ob de marine descripshun. An' B'rer B'ar, he get dem up berry cautious, an' didn't smash nuffin'.

Well, de time came for B'rer Rabbit to turn on de steam, an' de fust two engines, dey go off like young ducks inter de pond. An' B'rer Rabbit, he shake B'rer B'ar's paw—s'much as he could get hold ob—an' congratulated him on de excellence ob his work.

But when dey started up de third engine, she begin ter bump and wobble like a steam hammer celebrating Fourth ob July. An' B'rer B'ar, he stand fust on one foot and den on de other, looking mighty uneasy. B'rer Rabbit, he berry sick, but he dassent say much c'ase B'rer B'ar he much bigger.

B'rer Fox, he live nex' door to de lighting station, and when dat ole engine get under way, he wake up in a hurry an' think he'd dropped across an earthquake. When he found dat de ructions came from B'rer Rabbit's engine, he get berry mad, an' he come out in his pyjamas to find B'rer Rabbit.

D'reckly he sees him he hollers out, "What de furiosity d'you mean by waking respectable people in de middle ob de night by dat infunnel steam pendulum ob youahs? Ef you don't stop it at once and immeditly I'll call in de p'leece and imprison you for causing a nuisance."

B'rer Rabbit, he look berry pale, an' he says to B'rer B'ar, "Now you, get me out of dis! You put de blame thing up, an' if you don't stop de fuss, you'll suttenly hab to pull it down again!"

B'rar B'ar, he scratch his head, and den he sez, sezee, "Dis job am too tough for me, B'rer Rabbit! Call in Prof. Owl—berry clever, Prof. Owl is; does addishun an' subtrackshun ebbery day, an' has written a book on compound long division!"

"Ken he mend a fool engine?" sez B'rer Rabbit.

"Dat I don'no," sez B'rer B'ar. "Better ask him." Well, Prof. Owl, he come in, an' he sez he know all about dat engine. So he sits down an' he covers fohty seben an' a half sheets ob paper with abstruse calculations, an' then he sez, sezee: "De fault ob dat blame engine am dat it wobbles," sezee, "an' de reason it wobbles is dat it has too much unbalanced momentum due to de inertia ob de reciprocating parts," sezee. "I shall now attach a weight ob eleven tons six ounces to each ob de oscillating levers which work de air-pumps," sezee, "an' we shall have an equal inertia in de opposite sense," sezee, "for de weights come up as de piston comes down, an' de weights come down as de piston comes up," sezee; "an' we shall have an example of reciprocity," sezee, "an' de engine won't know it's running," sezee.

B'rer B'ar, he sez he see no sense at all in de thing, but he was shut up foh his impertinence by B'rer Rabbit, an' was told to mind his own business an' charge his own price. Which he did, an' de price was foah thousan' pounds!

Well, de weights ob eleven tons six ounces were attached to de pump-levers, and berry massive dey looked. B'rer B'ar, he was foh picking up a file to take off de roughness ob de castings, but Prof. Owl he stopped him with a scream.

"Holloa, B'rer B'ar! What you doin' ob? Ef you scratch dem castings," sezee, "de weight ob six ounces will be entirely eliminated, an' de effect will be altogedder spoilt!" So de castings was left quite rough.

Well, when dey started up de engine again, dey turned steam full on; an' de blame thing it wobbled wuss'n befoah! Prof. Owl took a hasty glance at his papers, an' then he sez, sezee: "Shut her down! shut her down! I've made a mistake in de decimal point, an' de weights should be one decimal one tons . . . . !"

But it was too late! De blame fool of an engine fell ober on B'rer B'ar, ker-splosh, an' killed him!

Prof. Owl, he wanted to see de effect ob running it as a horizontal engine, but dey weren't taking no moah risks.

ELECTRICAL ENGINEERING EDUCATION IN INDIA.

BRITISH INDIA possesses four admirable institutions for the training of civil engineers for the Public Works Departments, in the engineering colleges at Sibpur, Rorki, Poona, and Madras. In the general courses at these colleges there are some special classes in which a certain amount of electrical engineering is taught. In addition there are specific classes for the training of electrical engineers as such.

The Rorki College has a class for electrical engineers of the same status as the civil engineering class. The course extends over three years, the first year's course being in common with that for the civil engineer class. It prepares for the provincial service of the Public Works Department, the superior establishment of the Indian Telegraph Department, and the electrical engineering profession. There are guaranteed annually one appointment in the Public Works Department, and two apprenticeships corresponding to it, and also one or two appointments in the Telegraph Department. The course during the second and third years includes pure and applied mathematics, science, engineering, engineering practice, and surveying and drawing. The electrical engineering portion of the course includes the principles and practice of the various measurements used in electrical engineering; the principles on which are founded the action of electrical machinery, such as dynamos, motors, alternators, transformers, &c., with a description of their construction, testing, and management; followed by a description of the different methods of distributing electrical power, and the various types of mains, switches, lamps, and accessories. The above are practically illustrated by experiments in the electrical test room. The design of electrical

plant is also described, and the general scope of electricity in relation to the methods of distributing energy. The college is in possession of a fairly extensive electrical distribution, which is constantly being enlarged and is of great educational value. The curriculum includes a course in telegraph engineering.

Students of the Sibpur College, who have spent 3½ years in the classes and workshops, may be taken for training in the special course of electrical engineering, which lasts for a further period of 1½ years. Eleven were under training, and four completed the course in 1901-2. A student who passed the M.A. examination in 1901, and stood first in the B.E. examination in 1902, was awarded the Research Scholarship for studies and investigations in electricity and magnetism, with special reference to electrical engineering, in the laboratories of the college.

There is an electrical engineering class in the Poona College of the same grade as the sub-overseer's class. The course extends over three years, and during the first two years it is in common with that for sub-overseers and mechanical engineers. The special course for the third year includes (1) electricity, (2) applied mechanics, (3) mathematics, (4) materials and construction, (5) steam engine, and (6) workshop practice, with special reference to electrical engineering. In subjects 2 to 4, the course is the same as that in the mechanical engineers' class.

The calendar of the Madras College gives no information on the subject of the special training of electrical engineers.

Several industrial schools and classes in the Madras Presidency give instruction in practical telegraphy under the Madras technical examinations scheme. 119 students were returned as under instruction in six aided and unaided institutions at the end of 1901-2. The largest class is that of the aided Madras Telegraph School, which had 48 pupils on its rolls. The instruction given in these schools is mainly of an elementary character and is designed to train pupils as telegraph operators, &c. In 1901-2 only one student (who failed) presented himself for the advanced examination in practical telegraphy; six, of whom two passed, went up for the intermediate examination; and 89, of whom 41 passed, for the elementary examination.

It is only in regard to Rorki and Sibpur that the number of students in the Electrical Engineer Class are separately enumerated in the latest Government return. In the other colleges the numbers in these sections are included in other classifications. The Government, of course, has the pick of the students, and nothing is said in the latest Indian blue-book on "Professional and Technical Instruction in India" as to what becomes of those not selected for Government service. Isolated plants would probably absorb a few, while, in the course of a few years there should arise a demand from the central stations of Bombay, Calcutta, Madras, Rangoon, Lucknow, &c., for assistants in the subordinate grades of switchboard attendant and so forth.

THE POWER PLANT OF TALL OFFICE BUILDINGS.

Two papers bearing the above title were recently read before the American Society of Mechanical Engineers, by R. P. Bolton and J. H. Wells respectively. Both papers deal with the engineering features of those American buildings which have been appropriately named "sky-scrapers."

These tall buildings, rising to upwards of 25 stories, are rendered possible only by the use of a steel girder framework, the design of which comes within the province of the bridge engineer rather than the architect. The architectural features, in fact, are subservient to the engineering possibilities. Nor is the framework of the building the only engineering part of it. The heating arrangements, boilers, pumps, ventilation, electric lighting and power supply, and elevators all come within the province of the engineer. The height of a building appears to be limited only by the elevator service. Whilst we have no buildings reaching quite so far into the clouds as are found in American cities, the practice in London is tending towards larger and more elaborate blocks than in the past, so some details of American practice will be not only of interest, but also profitable.

The following details of a typical New York building given by Mr. Wells serve to indicate alike the magnitude of the work and the rapidity of erection. The Wall Street Exchange is about 100 ft. square, and is 25 stories, or 325 ft. high from the kerb level, and two stories, or 23 ft. in depth below the kerb. The grillage footings were set on the foundations in December, 1902; the erection of the superstructure was commenced in January, 1903, and completed from kerb level to roof in seven weeks. The brick walls were started in January, and finished on March 19th, 1903, and the building was partly occupied by tenants on May 1st, 1903.

The building contains 10,100 tons of structural steel work, and over 7,000,000 bricks. Wind pressure, floor loads, economy, and rapidity of construction, in addition to the mechanical, electrical, and sanitary arrangements, are all matters requiring the skill of experienced engineers; and the designing of such buildings has very materially changed the organisation of the architect's office, which is now divided into two parts, viz., the architectural and the engineering departments. The latter department is again sub-divided into constructional, mechanical, electrical, and sanitary departments, all dependent upon and working in conjunction with one another.

At least, this is the picture drawn by Mr. Wells, and it probably represents what he considers to be the ideal arrangement. The real, however, does not always come up to the ideal, and, according to Mr. Bolton's account, architects in the States are made of the same flesh and blood as those on this side of the herring pond.

He is referring more particularly to piping arrangements, and says "it is rare to find power piping and connections with which the operating engineers do not have trouble, and to which, changes have not infrequently had to be made."

The reason given might possibly be applied in some respects with equal force to this country, and is, therefore, worth quoting in full. It should be borne in mind that the architectural profession in America embraces largely both the duties of the architect and the consulting engineer.

"It must be added, with regret, that the architectural profession as a body have failed to realise their responsibility in regard to this matter of the employment of proper engineering skill upon the work of the design and proportion of the power plant of large buildings. The annoyances to which they have subjected the owners of such properties by such action, annoyances which are peculiarly inherent to systems of mechanical apparatus, have led to the present condition of the design and erection of tall office buildings, which has largely been taken out of the hands of the architects, and absorbed by general contracting firms. They employ a staff of subordinates, architectural as well as engineering, whose ability is stimulated by haste and competition, but whose methods naturally avoid the introduction of improvements which may add to the prime cost, which alone concerns their employers."

To return now to the other portions of these papers. As pointed out above, the limitation of height of buildings is not due to any difficulty of construction, but to the disadvantages felt by the occupants of the upper floors in being so remote from the street.

To an occupant of, say, a 20th-storey office, the use of stairs to cover the 250 ft. or so between his office and the street is quite out of the question. On the other hand, he has no monopoly of the elevator service, as hundreds of others want to go to various floors between the ground and his office, some going up, others down. If the elevator were liable to be stopped at every floor, a great portion of the day would be consumed in travelling. The design of a satisfactory elevator service is thus of the first importance. The cost of express elevators which stop only at the upper floors must, of course, be charged to those floors, and adds considerably to the rental, and this is quite necessary in buildings of 16 stories and upwards. In some buildings, elevators are operated as locals, stopping only at a certain floor. As regards speed, 600 ft. per minute is the practical limit for stopping cars and 750 for express cars. For

speeds greater than these more time is lost than gained by over-running the landings. Some of the elevators in the residential flats on the Norfolk estate in London are rated as high as 800 ft. per minute, though it is doubtful if this speed is ever made use of. The usual speed is nearer 400 than 800. It is seen, then, that the correct proportioning of elevator service in large tall buildings is a matter of some complexity. The nature and habits of the passengers must be considered, as the personal element enters largely into the question of an economical and satisfactory service.

It is interesting to note from Mr. Wells's paper that the electric elevator has been but little used on buildings over 15 stories in height, as they are not so suitable for high speeds as are hydraulic elevators. The author places the limit for electric elevators at 350 ft. per minute, whereas hydraulic may run at 600 ft. and more. He gives the relative powers for cars designed for loads of 2,500 lbs. as 6½ water-power-hours per car-mile for hydraulic, and 3½ KW.-hours per car-mile for electric elevators.

Mr. Bolton goes into somewhat more detail as to the operation of the cars on either system. The electric elevator, he says, is liable to considerable misuse, and suffers more than the hydraulic from the losses of over-running and of useless stops and starts by failing to make precise landings. This he considers due to some extent to the small and delicate character of the controls, the car attendants getting into a habit of fidgeting with the small levers. The disadvantages, coupled with the irregularity of operation, throwing a widely varying load on the generators, have retarded the use of electric elevators.

In London, and in this country generally, the opposite is the case, hydraulic elevators having in many cases been replaced by electric, with marked economy in operation. In some cases the saving is as much as 75 per cent. with electricity at 2½d. a unit from the public mains, and it is generally assumed that the electric lift will make four journeys to one of the hydraulic for the same cost. In America, these large buildings usually have their own generating plants, and with electric elevators an accumulator is generally necessary, adding considerably to the cost.

Then, as regards upkeep, the opinions given by the authors do not coincide with the experience over here. It is found here that the cost of maintenance is very much the same with electric as with hydraulic lifts. In one building named by the authors, the battery, necessitated by the five electric lifts, added the equivalent of 20 per cent. to the coal bill, besides which, one engineer was constantly employed attending to the operating mechanism, adding another $1,000 per annum.

The following quotation from Mr. Bolton's paper is given, not with the idea of depreciating electric lifts, but rather to show the trend of events in the States, and to profit, if possible, by the experience gained on the other side :—

"The maintenance of the form of electric elevator known as the Sprague-Pratt, or screw machine, and to a certain degree, of the other types of drum machines, is expensive, and out of all proportion to the cost of maintenance of an hydraulic mechanism. The former have been peculiarly subject to wear and tear. Screws, thrust plates and ball bearings require renewal, on an average, every 18 to 24 months. Constant attention and repair is required to the numerous details of the controlling mechanism. The work of repair and replacement of parts of electric elevators affords profitable employment for an entire works in this city, and further construction of the screw type has been definitely abandoned by its owners.

"The apparent economy of operation of an electrical system entirely disappears under analysis of these conditions, and the electric elevator stands to-day an economic failure for schedule service, while in point of simplicity, safety, ease of maintenance and control, the hydraulic elevator has maintained its reputation."

A sweeping statement of this kind sounds strange, coming as it does from the country where the electric elevator is considered to have reached the highest pitch of development, and this experience certainly does not coincide with the experience over here where the electric lift is rapidly ousting the hydraulic, and there is scarcely a maker of hydraulic lifts who has not thought it worth while to add electric lifts to his manufactures.

One other point brought out by Mr. Bolton on the subject of elevators is interesting and important, viz., the danger which open shafts offer in case of fire. In every case of a fire in these tall buildings, smoke has promptly found access to the elevators, rendering them useless. The shafts should, therefore, be enclosed separately, and the doors and grillage filled with wire, glass, or metal. The same consideration applies to the staircases.

(To be concluded.)

CAR WIRING.

Word of flaming tramcars running through the streets of a town sometimes reaches us through the newspapers.

Sensational journalism may paint the fires redder than real, but there is no denying that serious fire-risks do attend the street car as well as the heavy current train.

Indirectly, the blame for recent electric train disasters may be laid at the door of the tramcar, for we pointed out long ago the slap-dash and utterly careless way in which cars were wired, and we have observed little improvement since. If, then, the stringent precautions in use for house wiring have not been adopted and extended on electric trains, it is largely because of the bad example set by, and the shoddy traditions obtained from, the maker and buyer of tramcars in the past.

English fire offices have not yet thought fit to issue regulations governing the wiring of cars, and few buyers have even considered the necessity for mentioning the wiring in their specifications, while the makers have been much too engrossed in obtaining cut-price orders to suggest or carry out any improvements. In the case of the builders this inertia is not surprising, for it must be very bad wiring indeed which breaks down before the usual period of guarantee is up, and it is a mournful fact that the average car-builder has made no effort to keep in touch with the customer after the expiry of that period, so that he takes about ten times as long to take to heart the details in which longer service has exposed inherent weakness, or in which practical experience has suggested improvements.

It used to be the usual practice to hang the resistances under the car-body, either altogether unprotected, or inadequately so, from the mud and water thrown up by the wheels and the dust rubbed off by the brakes. Lightning arresters, fuses, and cables were similarly exposed. Quite recent practice is but a trifle better in these matters. The resistances may be covered by sheet-iron cases or hoods, but probably they are secured directly to the woodwork without the interposition of fire-resisting material. Cables, some of which may be at potentials differing by as much as 500 volts, are still bunched together in a canvas hose, which, far from being uninflammable, is usually treated with creosote oil or something similar, and this hose is run just as considerately as the plumber-electrician runs his twin bell-wire, while tappings are taken out here and there to be pulled through unbushed holes in the floor which soon will be reeking with moisture. Lighting circuits, too, are wired in the same casual way, the favourite run for the whole of the wires, whether positive or negative, being behind the line of ventilators, all bunched together without any protective covering.

We might enlarge further on the easy manner in which tramway undertakings do "medium" pressure wiring, comparing it with the manner in which every contractor for house or factory wiring has to carry out his "low" pressure work. It is well to remember in this connection that a car costs as much as a house rented at £20 to £40 per annum.

We want a standard set of rules for car-wiring such as the American Underwriters' National Electrical Association has just issued. These rules were framed by a Joint Committee of that Association and the American Street Railway Association, who had assistance from several members of prominent electrical manufacturing firms and insurance companies.

The rules have been under consideration for the past year, and they are reproduced in the July number of the *Street Railway Journal*. They are confined to pressures of 550

volts or less, and evidently have been drawn up with a special eye to heavy work, such as multiple unit trains.

The car framing over all motors of more than 75 H.P., and over resistances, arresters, contactors and cables, must be protected by fire-resisting material, but this may be omitted in the case of cables carrying less than 25 amperes, drawn into metal conduits.

We find some ambiguity in the specified treatment of cables carrying over 25 amperes, as stated in 32 *a*.1 and 32.*a*.4.

Cut-out and switch cabinets, or covers, are to be lined with fire-resisting material, and in all cases this material must be treated with a waterproof paint.

Cables drawn into metal conduits must be protected by an additional layer of braid.

Motor leads and other cables similarly exposed are to be protected by an additional layer of flame-proof braid at least $\frac{1}{32}$ in. thick, saturated with flameproof compound.

Cables carrying over 25 amperes are to be connected to switches, &c., by means of proper lugs or terminals soldered to the cables. Cut-outs, circuit-breakers and switches, must be enclosed in cabinets treated as above.

Metal conduits must be mechanically and electrically continuous, earthed, and watertight.

Casing is to be fire-proof except where the circuits are not exposed to damp.

Leads from trolley to enter car through water-tight bushings, and the same to apply to leads passing through floors.

Main circuit cables may be run (*a*) in metal conduits fitted with junction and outlet boxes where tappings are made or the cables leave the conduit; (*b*) in fire-resisting, insulating casing; (*c*) in insulated cleats spaced not less than 12 in. apart.

Resistances are to be placed with at least 6 in. air space between the resistance proper and the fire-resisting material protecting the car-body; and the insulation of resistance leads should be removed for 6 in. from the resistance terminal and replaced by a fire-proof sleeve.

Controllers to be raised above platforms by not less than a 1-in. wood block, painted and fitted to prevent moisture getting between it and platform.

The earth connection of lightning arresters to be not less than No. 6 B. and S., and to be run as straight as possible.

There are 50 rules in all, and those quoted in condensed form above are the most important, but all are worthy of careful study.

Engineers will be wise to overhaul the wiring of their old cars in good time, and to pay more attention to detail in new specifications. We see no good reason why car-wiring should not be done to at least as strict a specification as lighting engineers use to curb the sinful tendencies of wiring contractors. Car-builders also are not without sin.

THE BRITISH ASSOCIATION, CAMBRIDGE, 1904.

STANDARDS FOR ELECTRICAL MEASUREMENTS.

Report of the Committee, consisting of Lord Rayleigh (chairman), Dr. R. T. Glazebrook (secretary), Lord Kelvin, Profs. W. E. Ayrton, J. Perry, W. G. Adams, and G. Carey Foster, Sir Oliver J. Lodge, Dr. A. Muirhead, Sir W. H. Preece, Profs. J. D. Everett, A. Schuster, J. A. Fleming, and J. J. Thomson, Dr. W. N. Shaw, Dr. J. T. Bottomley, Rev. T. C Fitzpatrick, Dr. G. Johnstone Stoney, Prof. S. P. Thompson, Mr. J. Rennie, Principal E. H. Griffiths, Sir A. W. Rücker, Prof. H. L. Callendar, and Mr. George Matthey.

(*Read in Section A.*)

(*Concluded from page* 411.)

About this time, through the kindness of Prof. Ayrton, the results of some experiments by Prof H. S Carhart and Mr. G. A. Hulett, of the University of Michigan, were communicated to the Laboratory. Prof. Carhart has also sought a standard method of preparing the depolariser, and suggests that any prepared sulphate be washed with cadmium sulphate (or zinc sulphate for Clark cells), in order to prevent hydrolysis. Prior to this, Mr. Swinburne, in a letter to Dr. Glazebrook, suggested the precipitation of the sulphate intended for Clark cells from saturated solutions of mercurous nitrate and zinc sulphate, the washing to be effected with alcohol or saturated zinc sulphate solution.

Omitting the description of further experiments, the final mode of preparing the mercurous sulphate for standard cells is here given.

Fuming sulphuric acid saturated with SO_3 (32 per cent. of SO_3 is a convenient specification) is added to sufficient pure distilled mercury to ensure the latter being always in excess. The mercury should be contained in a clean glass vessel and violently agitated by a glass stirrer, so that the product may be in a fine state of division. After seven or eight hours the reaction will be sufficiently advanced for the sulphate to be separated from the acid, but if convenient, the action may go on for some days. Carefully pour off as much of the strong acid as possible into a large volume of water or into an empty vessel, and afterwards add the pasty product left to 30 or 40 times its bulk of distilled water. Mercury is precipitated, and a considerable quantity of heat is evolved owing to the dilution of the acid. A few minutes suffice for the sulphate to settle, when the acid liquid may be decanted, and the salt well washed by agitation with acidulated water (1 part of conc. H_2SO_4 to 10,000 parts of distilled water). Filtering follows, a filter pump being employed to effect exhaustion. It is advisable next to pound the damp sulphate thoroughly in an agate mortar to ensure the absence of small caked masses, after which acidulated water is again added, filtering effected, and the salt washed on the filter-paper with two or three lots of neutral saturated cadmium sulphate solution (or zinc sulphate solution for Clark cells). The salt is now removed to a small flask, saturated cadmium sulphate solution added, and the whole well shaken and then allowed to stand for 24 hours. Filtering follows, then three more washings with cadmium sulphate solution, removal to a flask once more with $CdSO_4$ solution, and at the end of 24 hours the solution should still be neutral to Congo red. If so, the sulphate may be filtered, and is ready for the manufacture of the paste. The whole of the operations should be conducted in a room screened from sunlight. As thus prepared, the mixture of mercurous sulphate and mercury is of a dark grey colour. Cells set up with paste prepared from it require no ageing, and the constancy obtained with pastes made from materials obtained from different sources is an indication of the purity of the salt.

Table III. gives the results of comparisons between cadmium cells set up with pastes prepared in this way and cadmium cell W 17. The latter in every case has the greater E.M.F. Differences are expressed in hundredths of a millivolt.

TABLE III.

Date of observation.	Cell No. 66.			Cell No. 67.			Cell No. 68.		
1904.	*a*	*b*	*c*	*a*	*b*	*c*	*a*	*b*	*c*
May 12th ...	−24	−26	−24		—			—	
„ 12th ...	−21	-20_5	−22		—			—	
„ 12th .	-20_5	-20_5	−21		—			—	
„ 16th ...		—		−27	−25	−28		—	
„ 16th ...		—		−22	−21	−21		—	
„ 16th ...	−21	−20	−20	−21	−21	−20		—	
June 13th ...		—			—		−29	−29	−27
„ 13th ...		—			—		−23	−22	−23
„ 13th ...	−21	-20_5	−21	−20	-20_5	−19	−21	−20	−19
July 6th ...	−21	−21	−20	-19_5	−20	-19_5	−20	−21	−20
„ 9th ..	-20_5	-20_5	−20	−20	−21	−20	−20	-20_5	-19_5

The first set of observations with each cell was made about five minutes after adding the solution; the second set of observations about 20 minutes afterwards; and the third set three hours afterwards. For the first two sets of observations, the temperature of the four-limb cells was unsteady; for the remaining observations they and W 17 were at the same steady temperature. Other cells of the Rayleigh H form have been constructed, and the comparisons are equally satisfactory.

An alternative method of preparing the salt was next sought. This second method is very simple. Any purchased sample of mercurous sulphate is heated together with mercury and concentrated H_2SO_4 on a water-bath for half-an-hour, the mixture being stirred occasionally. At the end of that time the remaining solid is allowed to settle and the hot clear acid carefully poured into a large volume of distilled water. Mercurous sulphate is soluble to a considerable extent in hot concentrated H_2SO_4; the result of the dilution is, in consequence, to precipitate the salt. As thus produced, the mercurous sulphate is in a finely divided state and of a pure white colour. It is well to at once admix with a little mercury and filter. The washing is performed as before. Portions of three purchased samples of Hg_2SO_4 were dealt with in this way, and, after treatment, gave identical results with the cells dealt with in Table III. The three original samples, prepared in the ordinary way, produced cells differing in E.M.F. from the standard by 40, 160, and 10 hundredths of a millivolt.

A third method devised by Prof. Carhart does not necessitate the use of concentrated acid. In order to hasten the reaction between mercury and dilute sulphuric acid (one to six) an electric current is passed from the mercury to a sheet of platinum foil suspended in the liquid. It is essential that the liquid be kept well stirred so as to keep the mercury surface exposed. Prof. Carhart has employed a beaker or crystallising dish to contain the liquids, and used a current of about 0·3 ampere; the current density, however, is not stated. At Bushy House the salt so produced has been compared with those prepared by the two previous methods Under ordinary circumstances about three grams of the salt—very grey owing to the presence of mercury in a fine state of division—is obtained per hour. The current density at Bushy House has been about ·01 ampere. It was gratifying to find that the product (washed as before) gave identical results with the other methods. Very violent agitation was maintained during the preparation. When the liquid

is not stirred a yellow compound (apparently turpeth mineral $HgSO_4.2HgO$) is also produced, and cells, the pastes of which are prepared with the product, have an E.M.F. when first set up more than a millivolt higher than the normal. Particular stress must therefore be laid on the instruction to keep the mercury surface well exposed. The same thing happened when attempting to form mercurous sulphate by the electrolysis of a saturated cadmium sulphate solution in an H-form vessel, the electrodes being pure mercury.

It will be observed that the remarks on the depolariser apply equally to Clark and to cadmium cells. Cadmium cells alone were made up in the final tests because of their small temperature coefficients; but Clark cells have also been set up and similar results obtained. It is also necessary to add that all purchased samples of Hg_2SO_4 are not so abnormal as those dealt with in Table I, nor does the E.M.F. of an abnormal cell always fall so rapidly as is indicated there. (The rate of fall is probably a function of the fineness of the sulphate.) Evidence of remarkably

Table IV.

Date of observation.	16>17	16>18	16>19	16>20	16>21
May 5, 1902	·00000	·00000	·00000	·00000	·00000
Sept. 12, „	0	+ 1	0	+ 1	0
Feb. 25, 1903	0	0	0	0	0
Dec. 14, „	+ 0_5	− 0_5	0	0	+ 0_5
Feb. 6, 1904	0	0	0	0	0
July 9, „	+ 0_5	+ 0_5	1_5	− 0_5	0

stable cells set up with purchased mercurous sulphate is afforded by six cadmium cells made at Bushy House in April, 1902; these have been in constant use, and in the case of two of them have frequently been short-circuited through 100 ohms. One of these cells is taken as a standard in the comparisons. By reference to a seventh cell made up in June, 1904, with a paste made from sulphate identical with that employed for the previous ones, it is thought probable that the whole six cells have fallen ·07 millivolt since their manufacture. Table IV. gives the result of the comparisons.

At the present time, the E.M.F. of a cadmium cell set up with a paste made from fuming sulphuric acid and mercury is less than that of these cells by 0·21 millivolt.

With respect to the other elements of standard cells it is proposed to investigate the cadmium and zinc amalgams, and the solutions of the sulphates of these metals, in a manner very similar to that employed for the pastes. Much valuable information has fortunately accumulated respecting the influence of impurities in these, so that probably the task is a light one. It is interesting to note that neither of the amalgams should have its surface exposed to the atmosphere for any length of time; it is preferably covered with water or a solution of the sulphate of the metal. This prevents oxidation. In addition to these investigations the effects of acidity and basicity are to be determined, together with observations in connection with lag, polarisation, temperature coefficients, &c.

Remarks on the Rayleigh H Form and the Board of Trade Tube Form of Standard Cells.

In 1892 Dr. Kahle, in a paper read before the British Association at Edinburgh, described some researches made by him on the Clark cell. Comparisons of H cells set up by him with tube cells set up by Dr. Glazebrook at Cambridge led to the assignment of an E.M.F. to the H cell, four ten-thousanths of a volt less than that of the Board of Trade form. This difference in value has been often quoted, and is at the present time accepted as a fact. In view of the discrepancies produced by the paste, together with theoretical considerations, it was thought desirable to investigate this difference if such should exist. For this purpose the H and tube forms of cell were combined. In addition to the usual terminals to the H cell, a zinc rod was inserted in the limb containing the paste, so that the

Table V.—*Differences in Hundredths of a Millivolt.*

Date of observation.	Clark cells.					Cadmium cells.	
	E 10.	E 11.	C 3.	C 7.	C 9.	49.	47.
1904.	H. T.	H. T.	H. T.	H. T.	H. T.	H. T.	H. T.
July 5th ..	−2 −8	+0 +0	−1 −7	+10 −2	—	+2 +2	+0 +1
„ 6th ..	+0 +2	+3 −5	+4 +0	+10 +7	—	+2 +3	+2 +1
„ 7th ..	—	—	+6 +2	+7 −2	+10 +2	—	—
„ 8th ..	—	—	+5 +1	+9 +2	+8 +15	—	—
„ 9th ..	+1 −6	+2 +0	+6 +2	+8 +12	+7 +3	+2 +2	+2 +1
Means ..	+1 −4	+2 −2	+4 −0,	+9 +3	+8 +7	+2 +2	+1 +1

arrangement of the elements in this limb was in accordance with the specification of the Board of Trade pattern. The sole difference in the elements of the H and tube cells was therefore the substitution of the zinc rod for zinc amalgam. In some cases the zinc rod was amalgamated, in others it was merely cleaned, in no case did it touch the paste. With two cadmium cells set up similarly, a rod of cadmium amalgam contained in a glass tube perforated at a few points replaced the plain cadmium rod. Very steady temperatures were maintained before taking observations.

Table V. gives the results of comparisons of these Clark and cadmium cells. The standard adopted for the Clarks was cell No. 10, a standard more than two years old and fairly constant; that for the cadmium cells, a third cell, No. 48, was made up at the same time.

Cells numbered E 10 and E 11 contained a different paste from that in C 3, C 7, C 9. The differences between H and T are small and irregular, and probably explained by the non-uniformity of the surface of the zinc rods and slight differences in the concentration of the solution. The zinc rods in E 10, E 11, C 3, and C 7 were amalgamated; that in C 9 was cleaned only.

The observations show that no such difference as 0·0004 volt exists between the two forms; the difference found in 1892 is to be attributed to other causes, probably the pastes employed.

STEEL IN CAR CONSTRUCTION.

Mr. William Forsyth recently read a paper on the use of steel in passenger car construction, before the Master Car Builders' Association in America. He showed that the development of the modern passenger car had been worked out almost entirely by the car manufacturing companies and not by the railroads. More attention had been given to decoration and the creation of an attractive interior than to increased strength in construction, which would contribute to greater safety. The higher speed of trains and a dense traffic, both freight and passenger, had increased the number of accidents, especially collisions, and the number of passengers killed and wounded by American railroads had increased to large proportions, which was not at all creditable to the management. The great number of casualties in such accidents was, he said, due in a large measure to weakness of the equipment, and the indications were that improvement in the strength of American passenger equipments had not kept pace with the faster schedules and more frequent trains, which increased the liability to accident.

Mr. Forsyth continued: "The competition between the different lines has advertised itself by offering to the public luxurious trains of buffet, dining, parlour and sleeping cars, which are built by the contracting car companies, and each successive train has added greater weight to the fast express trains until the locomotives are scarcely equal to the task of delivering them at terminals on schedule time. The railroads have apparently placed no limitations on the weights of these cars, and as the length has been increased to 70 ft., out to out end sills, the total section of wood sills and car sides has been increased to assist in supporting the wide space, and in this way modern sleeper or dining cars, built almost entirely of wood, have become heavier until they now weigh 60 tons per car. The contracting passenger car builders have no interest in the cost of transporting this load and the railroad officers have not carefully considered it. The passenger agent and the public are chiefly concerned with the effect of the beautiful interior with its luxurious furnishings.

"The record of the past year should suggest to sober-minded railroad managers that the element of safety in the construction of passenger trains as a whole deserves some serious attention, and the question of the excessive weight of parlour and sleeping cars must have a bad effect on the economy of operation. The parlour cars and sleepers are considered satisfactory in regard to strength in resisting wrecks and collisions, but they are not fireproof and their strength is obtained at the expense of great weight. They are thus a menace to the weaker cars, coaches, chair cars, baggage and mail cars in the front of the train. The average passenger train is not symmetrical in strength throughout its length, and the weakest part is in the most vulnerable place.

"The problem, then, is how can this ordinary equipment, in which the larger part of the passengers are carried and in which most casualties occur, be made as safe as the sleeping cars which, in wrecks, now ram them like a battleship in collision with a ferry-boat? The necessity for stronger passenger cars of the ordinary grade is not alone due to this fact nor to the high average speed of our trains, but to another reason, already mentioned, which has been illustrated in a number of fatal wrecks in the past year and which is the increased risk due to the presence of loaded 50-ton steel freight cars on the same or adjoining tracks. In collision with the old wooden freight cars the wooden coach had some chance of escape from total destruction, but, under present conditions, when engaged in a wreck with heavy steel freight cars, the wooden passenger car has been cut to pieces and ground up with its contents of human beings.

"Some of the reasons which have made steel construction successful for high capacity freight cars will also apply to passenger equipment when the length of the span becomes the important element instead of the carrying capacity in tons. It is often claimed that for equal weight, wood is as strong as iron or steel, and for ordinary rectangular beams this may be true, but it is not correct when steel is disposed in the shape of a deep plate girder with a thin web and heavy flanges.

"The majority of the large cars for long-distance electric lines are now built with steel underframes. The new cars for the Rapid Transit Co. of New York are built almost entirely of steel. These cars are 51 ft. 2 in. over platform sills, and they are 8 ft. 7 in. wide over sheathing. The cars have a capacity for 54 passengers. The Illinois Central Railroad has designed and built at its own shops quite a number of large steel suburban cars, having 100 seats. These steel cars have been in service more than a year, and one of them is on exhibition at the St. Louis Fair.

"I am aware of the fact that this subject is not a popular one, that many car builders prefer to think that wood construction is good

enough for passenger cars, but the use of steel for this purpose is gradually growing, and the conditions of our passenger service seem to indicate that before long it will be forced upon us. When the Interborough Co. of New York City decided to use steel cars it found it impossible to interest any of the large car builders of America, and the sample car was designed and built by the Pennsylvania Railroad Co. as an accommodation. Even after the car was built many were sceptical as to its success in service, but the tests of the car have been so satisfactory that the Interborough Co. has given the order for the construction of 200 steel passenger cars, and this is really the beginning of this industry in the United States. The Pressed Steel Car Co. has been for some time working on plans for steel passenger cars, and I understand that it is prepared to make contracts for the steel frame of such equipment."

THE EDISON AND JUNGNER BATTERY PATENTS.

There appears to have been trouble in America respecting the Jungner battery patents, and we quote the following report of some recent happenings from the New York *Electrical Review*: "A matter which has attracted a great deal of interest in the scientific world is the series of charges which Mr. Thomas A. Edison preferred some time ago against several patent-office examiners. This matter concerned an alleged deviation from proper practice in the case of Mr. Edison's patents on his new storage battery and the patents of the Swedish scientist, Jungner. Mr. Edison, in his complaint, charges principal examiner T. A. Witherspoon and assistant examiner A. M. Lewers, of the patent office, as follows:—

"'With incompetence, neglect of duty and maladministration of office in connection with the grant of United States patent to Ernest W. Jungner for reversible galvanic battery No. 738,110, dated September 1st, 1903; wherefore your petitioner and the public generally has and have suffered great and irreparable injury, and to the reproach and scandal of the patent office.'"

The specific charges are three in number:—

"1. The examiners in question allowed the Jungner patent to issue when they knew or should have known that such issue was fraudulent.

"2. The examiners allowed the said patent to issue containing claims which they knew were unpatentable, and which, in fact, they had declared to be unpatentable, and which Jungner himself had admitted were unpatentable.

"3. The examiners granted the said patent for an inoperative invention, which fact had been previously brought directly to their attention and acknowledged by them."

At the direction of the commissioner of patents Mr. Edison was given a full and complete hearing, which took place on April 4th, 1904, to suit the convenience of his counsel, Mr. A. D. Worthington, Mr. Melville Church and Mr. Frank L. Dyer. In connection with this matter Mr. Frank L. Dyer made a statement from which the following has been quoted:—

"Jungner apparently bases his case entirely on an application for a patent filed in March, 1899, but that application was entirely foreign to anything suggested by Mr. Edison, as it described entirely different active materials, not only specifically, but in their general character, and an entirely different mechanical construction. . . . . It appears that after the Edison patents issued in 1901, Jungner sought by amendment to include in his original application of March, 1899, some of the chemical and mechanical features of the Edison battery, in order to lay the basis for a claim covering the Edison battery; but the patent-office examiners in charge of these inventions detected the obvious character of such a subterfuge, and refused to permit the amendments to be made, on the ground that they embodied what is technically called new matter."

Mr. Dyer then states that Jungner "in June, 1902, filed an application for a patent that was represented as being a division of his original application of 1899. . . . Notwithstanding this fact, however, Jungner, in his alleged divisional application, introduced the same features of new matter that he had been prevented from introducing by way of amendment of his original case, and a patent was therefore granted to him on September 1st, 1903, disclosing chemical and constructional features that had been invented by Mr. Edison and disclosed in Mr. Edison's patents in 1901."

In his statement, Mr. Dyer relates the law establishing the validity or lack of validity of a patent granted in this way, and considers the further reasons leading up to the preferment of charges as follows:—

"Charges were therefore filed against the examiners, in order that they might either be dismissed or transferred to some other examining division. These charges were referred by the Secretary of the Interior to the Commissioner of Patents, and the latter gentleman reported that he had looked into them, and believed that they were without merit, and therefore recommended that no opportunity whatever be given to present them by way of argument. At this stage of the proceedings I saw President Roosevelt, who promptly decided that any respectful request which Mr. Edison might make was at least entitled to an orderly investigation, with the opportunity of a hearing; and it was therefore suggested to the Commissioner that this be done. Since the Commissioner had already informally passed upon the case, the matter was referred by him to his assistant, Mr. Moore, before whom, on April 4th last, a very full argument was made.

"I have before me the report of the Assistant Commissioner, of May 24th, 1904, to the Secretary of the Interior, in which the charges are very patiently, exhaustively, and fairly investigated, and in which our position is sustained in every important respect. Among other things the Assistant Commissioner says:—

"'It follows, therefore, that the disclosure in the Jungner patent is a different invention from that originally disclosed by him in his parent application, and therefore there is no basis in the original disclosure for the disclosure of his patent. . . .

"'I find, therefore, that the examiners erred in allowing the Jungner patent as a division of the earlier application, as the patent is not in fact a division, for the reason that it not only contains new descriptive matter relating to its mechanical structure, but the invention disclosed is so changed as to be in fact another invention from those originally disclosed in the early application, and that the patent therefore as to this new matter is effective only as to its new filing date.'"

"And in his conclusion he says:—

"'To so view the effect of the enlarged and changed description of the patent to Jungner is, in my opinion, a grave error of judgement, and in view of the statements of the examiners above referred to, the conclusion is inevitable that they are unable to appreciate the fact that the description in the patent is so changed and enlarged as to cover a battery having the characteristics of the claim which they rejected on the ground of new matter in the original application.

"'Having reached this conclusion, I am of opinion that the examiners should be relieved from their present assignment in Division 3, and transferred to duty in other examining divisions of this office, and that other examiners should be assigned to Division 3, in which division applications for patents belonging to the class of electro-chemistry are examined.'"

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

18,628. "An improved electric lamp-holder or socket." G. B. Stern and A. C. Greene. August 29th.

18,635. "A method of generating electricity." D. Cook. August 29th.

18,642. "Improvements relating to means for the production and application of electrical resonance." H. Manders. August 29th.

18,663. "Improvements in and relating to the control of alternating current electric motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) August 29th.

18,704. "Improvements in, or relating to, electrical circuit-breakers and automatic switches." The Electric and Ordnance Accessories Co., Ltd., and R. F. Hall. August 30th.

18,793. "Improved means for controlling the flow of electricity into third or operative rails or similar appliances for vehicular or other traffic, the said means being also available for signalling purposes." J. Graham and R. Kendal. August 31st.

18,813. "Improvements in or relating to electrical switches and the like." J. Taylor. August 31st.

18,827. "Thermostatic electric circuit controller." C. Klopfenstein and G. Klopfenstein. August 31st. (Complete.)

18,831. "Improvements in and relating to telegraphic and like electric circuits." W. K. Kise. August 31st.

18,840. "Improvements in and relating to processes of electro-deposition." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) August 31st.

18,841. "Improvements relating to electric transformers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) August 31st.

18,855. "Improvements in or relating to wires or conductors for electrically-propelled tramcars and other vehicles." R. Green. September 1st.

18,910. "Improvements in electrical heaters." L. B. Pemberton. (Date applied for under Patents Act, 1901, January 4th, 1904, being date of application in United States.) September 1st. (Complete.)

18,919. "An improved terminal or coupling for electric cables." W. Middleton and J. Y. Middleton. September 1st.

18,940. "Improvements in and relating to the manufacture of electrical insulating and non-heat conducting compositions." H. H. Lake. (Société Anonyme Matthey & Co., Switzerland.) September 1st.

18,942. "Improved means for advertising on electric tramcars." R. T. Simcock. September 2nd.

18,949. "A safety guard for conductor or live rails on electric railways." G. D. Sale. September 2nd. (Complete.)

18,959. "Improvements in electric lamps." O. D. Lucas. September 2nd.

18,979. "Improvements in or relating to electric traction." R. S. Clouston. September 2nd.

18,987. "Improvements in systems of electrical distribution." P. H. Thomas. (Date applied for under Patents Act, 1901, September 4th, 1903, being date of application in United States.) September 2nd. (Complete.)

18,991. "Improvements in systems of electrical distribution." P. H. Thomas. (Date applied for under Patents Act, 1901, September 4th, 1903, being date of application in United States.) September 2nd. (Complete.)

19,000. "Improved means of rectifying alternating current, named 'Aluminium rectifier.'" F. S. Porah and S. G. Livett. September 3rd.

19,084. "Improvements in wall plugs for attachment of electric fittings and the like." J. B. Haynes and J. Hirchcliffe. September 3rd.

Westinghouse S.P. Railway System.—It is stated that an experimental single-phase railway line is to be constructed at the British Westinghouse Works, at Trafford Park. It is expected to be in operation before the end of the year.